Railway Mechanical Engineer

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Foreman material

A correspondent, "Corporal Smith," tells in a communication in another column of a peculiar incident that happened in a locomotive repair shop with which he is acquainted. Not a few industrial economists and welfare workers have spent much time and patience attempting to determine what the worker thinks about his job and his bosses. The difficulty is to find any two workers that see things from the same point of view or really spend much intelligent effort in trying to think through the problem of industrial relationships. Here, however, was an ambitious young worker, who promptly and deliberately turned down an increase of wages beyond that of his associates, because he did not want to incur their enmity; he indicated also that he was interested in raising the wage-earning level of the entire group, although recognizing that he possessed special ability as a producer. Apparently he did look forward to the possibility of capitalizing upon his achievements in time by being advanced to a supervisory position. Our correspondent asks whether such a man really possesses "foreman material." The question is squarely up to our readers to answer. What do you think about it?

Simplifying instructions for car repair work

Letters of instruction pertaining to the kind, amount and cost of repairs to be made to different series of cars constitute one the largest and most voluminous correspondence files in the office of the average car shop superintendent or foreman. Each time a car or series of cars is brought into the shop for repairs is usually an occasion for referring to this file to ascertain what repairs the car should receive. Sometimes there are several letters of instructions pertaining to the repairs to be made on a single series of cars scattered through the file. Usually the second letter amends or adds to the first, a third letter may refer to the first and amend the second, and so on indefinitely. Checking through such a large amount of correspondence is not only confusing and a waste of time, but there are possibilities of making mistakes.

The car department of an eastern railroad has taken steps to eliminate this difficulty by compiling all of the instructions pertaining to each series of cars on a single typewritten form. This form is divided into three columns, the first column giving the serial number of the cars and the year they were built, the second column giving the number of cars in the series, and the third column giving the instructions as to maintenance and betterments as of the latest revision. Drawing numbers, amounts allowed for labor and material, names of appliances and the names of all other parts to be changed or renewed are included in the third column. The condensed instructions prepared by the head of the car department for May, 1927, required exactly 9½ letter size sheets, with triple spacing between the instructions for each series of cars, and this list gave all instructions necessary to make the repairs to a total of 49 series of cars.

Quoting the officer in charge of the car department which has recently placed this system in effect, "It not only simplifies the instructions but it saves a lot of time for everybody by not having to do so much talking on the telephone."

Who represents your road at conventions?

From time to time there has been a tendency on the part of some railroads to investigate the attendance of their employees at railway association conventions, and in some instances certain roads have gone so far as to prohibit the further attendance of employees at the expense of the company. It is difficult to say just what may have prompted such investigations. The suggestion may be ventured, however, that the time has probably come when, in view of the increasing expense attachd to sending large numbers of officers and supervisors to the different conventions, the railroads are making an effort to determine the actual benefit that the company derives from such meetings. There can be no question but that the intensive modern development of our transportation machine has been brought about, not alone by the efforts of a few unusually capable men, but by carrying out the collective ideas of the greater part of those who direct the operation of our railroads. One profits by an insight into the thoughts of others and by the opportunity to discuss with others the manner in which the many problems of railroad operation are solved. It is only through some organized effort, such as that put forth by associations, that the ideas of railroad men from all parts of the country can be collected and made available to all. One good idea brought back from a convention and put into practice may more than pay the expenses of all of the men which a company may send.

Whether or not any railroad company is enabled to profit by improved ideas as a result of the attendance of its men at conventions will depend primarily upon two things: what kind of man is sent, and how active a part he takes in the work after he gets there. A single convention in many cases represents the expenditure of many thousands of dollars, not only on the part of the organization holding it, but on the part of the manufacturers who may exhibit and on the part of the railroads which pay the expenses of their men who attend. That our railroad association meetings are a success is probably best evidenced by the fact that most of the associations showed a marked improvement each year in the quality of the technical papers that are pre-

sented and the caliber of the men who are prevailed upon to speak during the sessions. That the attendance at each is increasing yearly is an evidence of appreciation on the part of the majority of the railroads of the fact that these conventions are capable of serving as an extremely valuable part of the education of their employees.

Some railroad men are inclined to look upon the opportunity to attend a convention in the light of a vacation. In many instances some delegates have so far failed to recognize their responsibility to their employers as to spend a relatively small part of their time in attendance at the sessions and rarely, if ever, to take any active part in the discussion of the papers that are presented. It is fortunate that such instances are rare, but that it ever exists is an indication that some railroad officer has failed in his duty if he has not given serious thought to the intelligent selection of the men assigned to attend conventions. It is true in this, as in most other things, that a man will profit from his attendance in direct proportion to the effort that he makes to contribute something to the success of a convention. New ideas can never be picked up by a man who spends practically none of his time in attendance at the sessions, but on the other hand any man who will conscientiously attend all of the sessions even though he takes no active part in the discussion, cannot fail to learn something that will contribute to his own personal advancement and result in profit to the road for which he works. The future progress and success of railroad association work will depend upon the interest of men who have a growing appreciation of the responsibility imposed upon them by their presence. The railroads, on the other hand, can not only contribute to the advancement of the work, but can derive greater benefit themselves by looking pretty carefully into the type of men that are sent to a convention.

Apprentice training developments

Industry, as well as the mechanical departments of the railroads, has been deeply concerned in recent years over the problem of recruiting and training apprentices. It must be admitted, on the other hand, that many industrial executives and not a few mechanical department officers have been more or less indifferent to this need, or have been skeptical of the necessity for or efficacy of apprentice training under modern industrial conditions. Correspondence and personal contacts with apprentices on some railway systems have indicated an almost deplorable state of affairs. Apprentices have been hired as such, but in some instances very little if any intelligent attention has been given to their training and development—they have simply muddled through the four years, although many times a sympathetic mechanic or capable foreman may have been a real inspiration and a great help to them on certain parts of their work. As against this, several roads have gone about the task of training apprentices in a painstaking and thorough way, keeping in touch with the best thought and the most advanced practices in industry.

Steadily, gradually and almost imperceptibly, more and more officers and supervisors have awakened to the necessity for and the possibilities of the more discriminating and careful selection of apprentices and their proper training and development. Not a few railway mechanical department officers and supervisors point with enthusiasm and real conviction to the results of modern methods of apprentice training. A real impetus has been given this movement in the past three or four years because of the remarkable improvement in employee relations which has taken place since 1922, and also because of the higher standards of supervision which have resulted from the foremanship training movement, if we may use that term in a broad way to include both the formal steps toward that end on some roads, and the less well-defined and more or less informal measures of various sorts on other roads which are proving effective, but which might not necessarily be recognized under the designation of foreman training.

As one result we find a number of more or less radical departures from some of the detail methods and practices which were almost regarded as standard on the very few roads which seriously went in for modern apprentice training a number of years ago. This is not strange, for at that time two or three names would have included the outstanding apprentice training leaders. Today the movement has been very greatly extended, a number of the present leaders having obtained their experience under the men who started the movement in the railway field.

Some of the departures from the older practices have been suggested by developments which have taken place in the general educational field in recent years. Others have been inspired by critical study and observation on the part of thoughtful apprentice supervisors, who have been trying to find ways and means of making apprentice training more effective. Incidentally, the Mechanical Department of the American Railway Association might well consider setting up some sort of committee or clearing house, in order that the most successful of these experiments and practices may be brought to the attention of the entire field. Naturally, some of these methods have been demanded by peculiar or special conditions at certain places or on certain roads, and the conditions under which any practice has proved a success should be understood before attempting to apply it in other places.

A rather unique and unusual scheme is being tried out on the Baltimore & Ohio and the Missouri Pacific, a description of which will be found elsewhere in this issue and in the September number of the *Railway Mechanical Engineer*. It is only just well started, having been inaugurated on the Baltimore & Ohio last September and on the Missouri Pacific in November. Naturally, it is too early to pass final judgment upon it, because the inauguration of any new movement of this sort is usually promoted with enthusiasm during its early stages—the test will come when it settles down to the long hard pull after it has become a routine matter to the apprentices and those in charge. Moreover, the results of educational processes of this sort do not become immediately evident and the final answer can only be found when the product of the courses—the journeymen mechanics—have had ample opportunity to demonstrate what the training has done for them in a practical way. This, of course, is a matter of years. It may not be unprofitable, on the other hand, to make a critical examination of the methods used on these two roads to see whether any tendencies may be found which are illogical, and whether the methods appear to be on a sound, commonsense basis. In launching a new movement on so large a scale it is of course necessary to feel out the way to a certain extent and to introduce improvements or modifications as experience may dictate.

The article by Hayes Robbins is of special interest also because, while Mr. Robbins has been closely associated with mechanical department officers and problems in recent years, he is not a technically trained mechanical department officer, but has approached the problem more as an industrial economist and

one who has some understanding of modern educational principles and processes. It is unfortunate that some applications of apprentice training in the past have been promoted by men who, while they have had a thorough technical training in the railway mechanical department, have had little or no training or experience in educational work and have not kept closely in touch with vocational training methods or industrial developments.

Mr. Robbins' observations should prove of peculiar interest and value to those mechanical department officers and supervisors who are interested in this new application of apprentice training methods.

Work of the American Welding Society

Elsewhere in this issue appears the technical program of the American Welding Society to be presented at the fall meeting to be held during the week of September 19 at Detroit, Mich. In addition to the technical sessions of the American Welding Society there will be held at the same time a convention of the American Society for Steel Treating, the fall meeting of the Institute of Metals and the National Steel and Machine Tool Exposition. Each of the technical societies has prepared a splendid program.

Of particular interest to the railway industry will be the activity of the American Welding Society. Welding received its first great impetus in the railroad field, which has done much in its development and still is contributing valuable practicable information imperative to the further development of the science of welding. Many railroads have not given the American Welding Society their fullest co-operation. Perhaps the reason for this lack of co-operation is the fact that railroad shops are widely scattered, which prevents the proper dissemination of information on welding. The railroads should bear in mind that the American Welding Society is a central clearing house for accurate information on the development of the art of welding.

Perhaps many railroads are not entirely familiar with the work that the American Welding Society is doing in order more fully to develop the general science of welding. The work of the Society is carried on through a number of channels, most important of which are local sections, publications, national meetings, research department committees, and information service. Perhaps the most important of these are the activities of the research department, known as the American Bureau of Welding. It also acts as the welding research department of the National Research Council. The purpose of the Bureau is to bring to bear on the solution of welding problems the latest scientific knowledge and the scientific method of attack. To this end the co-operation of all interested in scientific and engineering organizations has been enlisted. It also provides an organization the reports of which are accepted the world over as sound and free from commercial bias. The work of the Bureau is carried on through research sub-committees, each handling specific problems. Among the problems now receiving consideration may be listed (1) welded rail joints, (2) welding pressure vessels, (3) welding of structural steel (4) welding wire specifications, (5) fundamentals of arc welding and (6) fundamental problems in welding, all of which are applicable to welding in the railway industry. As an example of the scope of the work carried on by these committees, in the field of pressure vessels the Bureau carried out a $15,000 investigation to supply engineers and particularly the A. S. M. E. boiler code committee with needed information which would enable it to draw up a satisfactory code governing the use of welding in the construction of pressure vessels. Recognizing the incompleteness of the present code, the A. S. M. E. has recently authorizd the conduct of a joint investigation with the American Welding Society of much greater scope which will not only include particular tests but many fundamental investigations in the nature of welds and which will probably involve an expenditure of $100,000.

In addition to specific research problems the Bureau maintains a technical information service. During the past year several hundred requests for information have been satisfactorily answered. When the information is of general interest, the questions and answers are published in the Journal of the Society. Thus, it can be readily seen that through the American Welding Society reliable information and data can be secured pertaining to all branches of welding. Are the railroads taking the fullest advantage of this fund of reliable technical information pertaining to welding? Are the railroads doing their share in co-operating with the Society pertaining to the welding problems to be solved in the railroad industry? The railroads have many men well versed in the science of welding. These men should avail themselves of the opportunities offered by the Society to take an active part in its committee work and paricularly in the activities of the American Bureau of Welding.

Economy in good housekeeping

Substantial economies can be effected at practically all railroad locomotive shops, car shops, engine terminals and rip tracks by more intensive efforts to keep materials and tools picked up, floors or tracks clean and working facilities arranged in an orderly manner. There is economy in good housekeeping which brings returns in many different ways, some of which do not appear on the surface.

As the result of a recent campaign a particularly clean and orderly condition prevails at the Fortieth avenue, Chicago, shops of the Chicago & North Western. This desirable condition was not brought about without work. Everyone knows that the average shop man has a pronounced inclination to collect and store away against possible future need every kind of material and tool for which he has or thinks he may have a use. An energetic clean-up campaign, conducted during recent months at the Fortieth avenue shops, was drastic in extent and produced striking results. Chisels, hammers, monkey wrenches and small tools too numerous to mention were taken from drawers, under benches, concealed in lockers and in fact from the most unexpected places. Bolts, nuts, washers, valves and similar small material were found in large quantities, which, together with the surplus stock on hand in the various shop departments, made more than a car load of material returned to the storeroom. Much of this material had been stored or hidden away so long that its existence was forgotten and its return to useful service accordingly effected a saving to the railroad which more than offset the cost of cleaning the shop.

The following are some of the things which were done in improving the shop as regards order and cleanliness: All material and tools not needed for specific jobs were removed from bench drawers and lockers; floors were swept clean, particularly under benches; all dark rubbish-filled corners were cleaned; machine beds were cleared of old tools and waste; in the blacksmith shop, material of all kinds was removed from under furnaces, forges and anvil blocks; tool racks

were built to hold tools off the floor and within convenient reach; wooden lockers and benches were replaced where possible with steel; and suitable steel racks were provided to keep material of all kinds off the floor to the fullest extent practicable. The effect of these changes was to give an impression that here was a shop in which the supervision was distinctly alive, on its toes and quick to take advantage of any opportunity for improvement in shop operation.

The advantages of maintaing a clean shop are manifold. Aside from increased safety, decreased fire hazard and a substantial material saving, there is no question that the average shop man prefers to work in a clean shop and can do better work and more of it. The morale of the shop forces is unquestionably improved. The work of supervision is also materially lessened, because with far less material on the floor, each department foreman can keep in closer touch with the progress of work on particular parts called for by the schedule. His attention is not distracted by constantly seeing material under foot, much of which may not have been worked on in some cases for weeks.

While the cost of the initial clean-up of a shop is quite appreciable, the saving in material usually amounts to more than enough to offset it; both the work and cost of keeping a shop clean, once it is put in the proper condition, are materially reduced. Probably it is possible to place too much emphasis on shop cleanliness and order to the exclusion of other important matters, but unless some interested officer in authority makes cleanliness more or less of a hobby and instills into the minds of his foremen and men the advantages to be gained, no shop will remain clean even after being put in first class condition. Earnest and constant attention to this important subject are essential.

New Books

Human Relations in Railroading, by Hayes Robbins. 160 pages, 5 in. by 7½ in. Bound in cloth. Published by the General Publishing Company, 30 Church Street, New York, Price $2.00.

The *Railway Mechanical Engineer* and its predecessors have for many years advocated the better selection and training of employees and higher standards of supervision. It is doubtful if any publication in any field in industry has devoted more consideration and space to the question of apprentice training during the past quarter century. In addition to editorial comment and special articles, several competitions have also been promoted for the best articles on foremanship. A lively controversy between "Bill Brown" and "Top Sergeant" on the methods of dealing with the workers will not soon be forgotten.

The question of human relations in railroading has been regarded as a matter of exceedingly great importance by the leading railroad publications for a number of years. In spite of this and the increased activity along the lines of personnel administration very little has been written about it outside of the pages of the railway periodicals; indeed, the lack of good books on this subject has been commented upon many times and it has been necessary to direct our readers largely to treatises related to industry at large when inquiry was made for books concerned with human relations in railroading.

Hayes Robbins in his book on that subject has approached the question in a unique way. He discusses frankly the result of certain experiments which were made after the road with which he was connected decided that it would be advisable to take steps to improve the relations between the management and the workers. A survey indicated that there were a number of practices already existing which could be used as a basis for more extended experiments. There were, for instance, various committee activities, including safety first, fuel conservation and freight claim prevention which helped to promote better contacts between the supervisors and the men in the ranks. Mr. Robbins tells how experiments were made to intensify and extend these activities with a view to promoting better understandings and closer relationships. Eventually annual conventions were held jointly by these committees, with an attendance of 400 or 500, one-third of which was voluntary, the others being committee members.

Experiments were made in launching foremen's clubs, with a view to promoting better teamwork, better understanding of the foremen's responsibilities and improved methods of supervision. Some mistakes were made, but building upon these a new start was made and a series of strong and active clubs was developed, meeting monthly except during the summer season, and holding one combined meeting annually. It was found after these clubs had been functioning for a couple of years that a large part of the foremen had enrolled in special correspondence courses for supervisors. Naturally these things tended to focus attention upon apprentice training and then upon the training of the adult workers, better to fit them for their work and for promotion. Mr. Robbins tells also of the attempt which was made to encourage suggestions from the workers and the various steps which were taken until a formal plan was established, which has met with a certain degree of success.

These particular chapters on New Contacts, Foremen's Clubs, Adventures in Education and An Experiment in Suggestions, are of special interest to readers of the *Railway Mechanical Engineer*. Other matters which are discussed and which will also be of interest are, Why the Employees' Magazine, Insurance and Pensions, the Responsibility of Management, which includes the discussion of the handling of personnel work, and other problems, such as stabilization of employment, provision for emergencies and conveniences for operating employees at layover points. The final chapter makes suggestions for the setting up of a clearing house for all of the railroads on questions relating to personnel and human relations. An appendix includes a revision of an article entitled, "Panaceas and Possibilities," which was contributed by Mr. Robbins to the Railway Age and which discusses the possibilities of the Watson-Parker railroad labor law.

Mr. Robbins' treatment of those questions which are of particular interest to the mechanical department is unique. He approaches them as an economist and educator rather than a technically trained mechanical department officer, although he was closely associated with that department in the experiments which he describes and for which he was largely responsible. Approaching these questions from this point of view has certain advantages. The mechanical department officer too frequently lacks the broader viewpoint of the economist and seldom possesses a knowledge of up-to-date educational processes. Mr. Robbins having these qualifications and working with and through technical men, made a rather unusual combination.

The book is not very large, is attractively arranged and printed and should do much to stimulate right thinking in the direction of improved human relations in railroading.

High pressure steam locomotives*

Modified cycle proposed—Comparison of Schmidt-Henschel locomotive with Pennsylvania I1S and Baldwin No. 60,000 show possibilities

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THIS paper attempts a somewhat more extended survey of the efficiencies obtainable with various steam pressures than that contained in the paper by Professors E. C. Schmidt and the late J. M. Snodgrass, presented by the Railroad Division at the annual meeting of the American Society of Mechanical Engineers in December, 1926, and examines the effect of the ratio of expansion on the efficiency.[1] For this purpose the Rankine cycle does not offer a satisfactory basis of comparison, and a modification suggested by the author in discussing the Schmidt and Snodgrass paper is used. This is referred to hereafter as the "locomotive cycle." It assumes that the steam is admitted to the cylinder at constant pressure and temperature and then, after cut-off, is expanded adiabatically to the release pressure corresponding to the ratio of expansion desired. Release is assumed to take place at the end of the stroke, and the pressure is assumd to fall immediately to the back pressure against which exhaust takes place. The cylinder is assumed to have no clearance.

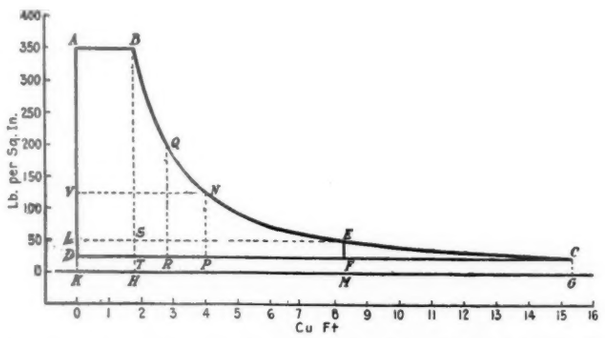


Fig. 1—Theoretical indicator diagram for adiabatic expansion of 1 lb. of steam from 350 lb. per sq. in. absolute and 650 deg. F.

Comparison of the Rankine and "locomotive" cycles

Fig. 1 illustrates diagrams of this "locomotive" cycle in comparison with a Rankine cycle diagram. *ABCDA* is the Rankine diagram for admission at 350 lb. per sq. in., adiabatic expansion to 25 lb. per sq. in., and exhaust at 25 lb. per sq. in. *ABEFDA* is a diagram of the locomotive cycle with admission at 350 lb. per sq. in., adiabatic expansion to a release pressure of 50 lb. per sq. in., and exhaust at 25 lb. per sq. in. *ABNPDA* and *ABQRDA* are locomotive cycle diagrams with conditions similar to *ABEFDA,* except that the release pressures are respectively 125 and 200 lb. per sq. in. *ABTDA* is a locomotive cycle diagram with full stroke cut-off, the release pressure being the same as the admission pressure, 350 lb. per sq. in.

The present study of high steam pressures is based on the assumption that no fundamental change in locomotive design is made. It is assumed that if the steam pressure is increased no changes will be made in the locomotive design except those necessary to enable the steam at the higher pressure to be produced safely and to be utilized efficiently. For the locomotive boiler a pressure of 250 lb. per sq. in. is usually taken to be about the maximum that can be carried with the conventional firebox with its sheets supported by staybolts. The use of the higher pressures with which the paper is concerned will require some form of water-tube firebox, but will not force any other vital change. Consequently there seems to be no reason to assume any great change in steam temperatures. At present steam temperatures range normally between 600 and 700 deg. F., according to working conditions. In the calculations which follow the steam is assumed to have a temperature of 650 deg. F., during admission to the cylinder, irrespective of the pressure.

Another factor stabilized in the locomotive is the minimum exhaust pressure. Exhaust must be made to the atmosphere and therefore the least back pressure must be higher than atmospheric. In actual practice the exhaust pressure varies betwen 20 and 50 lb. per sq. in. absolute, according to the rate at which steam is passed through the cylinders. For present purposes the exhaust pressure for the theoretical indicator diagrams which are computed, is assumed to be in all cases 25 lb. per sq. in. absolute.

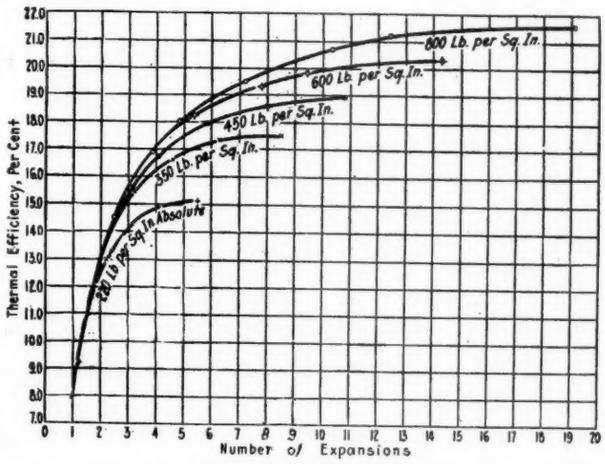

Thermal Efficiency, Per Cent
Number of Expansions
800 Lb. per Sq. In.
600 Lb. per Sq. In.
450 Lb. per Sq. In.
350 Lb. per Sq. In.
250 Lb. per Sq. In. Absolute

Fig. 2—Relation between cylinder efficiency and expansion for various steam pressures

(In all cases admission temperature is 650 deg. F., and exhaust pressure, 25 lb. per sq. in.)

Applying the "locomotive" cycle

We now take up in detail computation and comparison of theoretical indicator diagrams and apply the locomo-

*Abstract of paper contributed by the Railroad Division and presented at the spring meeting of the American Society of Mechanical Engineers, White Sulphur Springs, W. Va., May 23 to 26, 1927.

[1]See Railway Mechanical Engineer, January, 1927, page 4.

tive cycle to various admission and release pressures. In what follows it is convenient to measure all pressures in pounds per sq. in. absolute. The properties of steam used are taken from Keenan's Progress Report on the Development of Steam Charts and Tables from the Harvard experiments.[2] In all of the theoretical indicator diagrams the temperature of the steam on admission is taken as 650 deg. F., for all pressures, and the back pressure during exhaust is taken as 25 lb. per sq. in., absolute.

Fig. 1 shows the adiabatic expansion of one pound of steam from a pressure of 350 lb. per sq. in. and

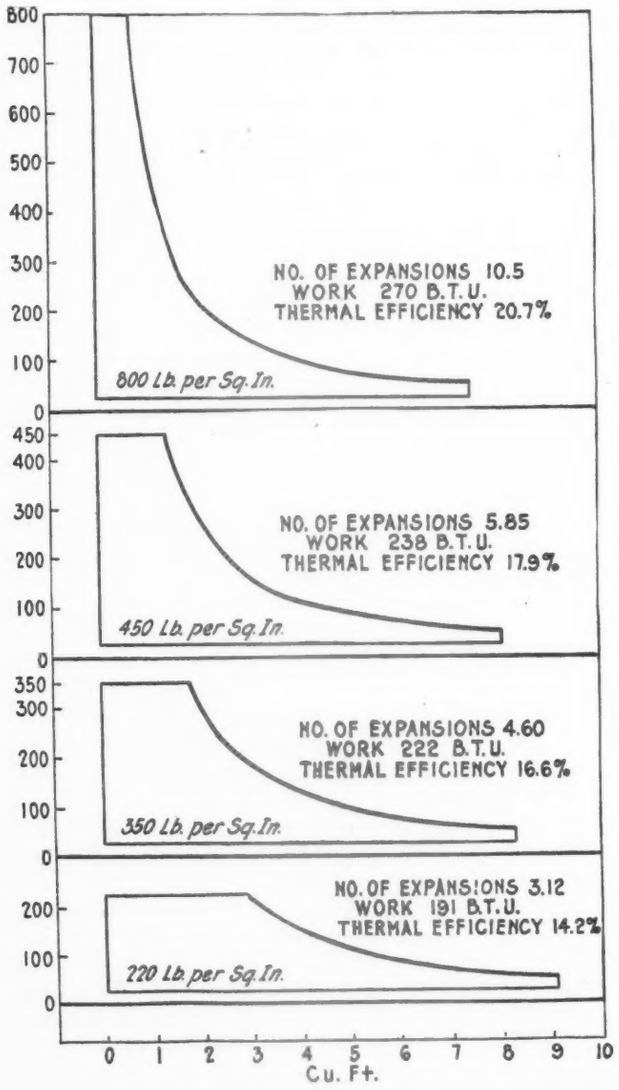


Fig. 3—Theoretical diagrams for various steam pressures, adiabatic expansion

(Admission temperature, 650 deg. F.; release pressure, 50 lb. per sq. in.; exhaust pressure, 25 lb. per sq. in.)

650 deg. F. Admission of one pound of steam, from *A* to *B* at full pressure and temperature, gives a volume of 1.80 cu. ft. The external work done by the steam during admission is 144 x 1.80 x 350 ft.-lb., which is the equivalent of 0.1852 x 1.80 x 350 = 117 B.t.u.

Now the steam tables show that at 350 lb. per sq. in. and 650 deg. F., the total heat energy per pound of steam is 1,338 B.t.u. Deducting from this the external work as above, leaves 1,221 B.t.u. as the internal energy of the steam at cut-off. The curve *BEC* has been determined from the steam tables to show the drop in pressure and increase in volume during expansion. At C., with a pressure of 25 lb. per sq. in. absolute, the volume is found to be 15.3 cu. ft., and the quality 0.938 per cent. Under these conditions the steam has a total heat energy of 1,103 B.t.u. with an external work value of 0.1852 x 15.3 x 25 = 70 B.t.u., giving an internal energy of 1,033 B.t.u. As expansion is assumed adiabatic no heat is received by the steam and all the heat given up during expansion is transformed into work. Therefore the external work done during expansion is 1221—1,033=188 B.t.u. To complete the cycle the steam must be exhausted. This is assumed to take place at a constant back pressure of 25 lb. per sq. in., giving the line C.D. The work lost is 0.1852 x 25 x 15.3=70 B.t.u. The net work done by the steam during the cycle is therefore as follows:

During admission	117 B.t.u.
During expansion	188 B.t.u.
Total	305 B.t.u.
Lost during exhaust	70 B.t.u.
Net work of cycle	235 B.t.u.

This sequence of operations, admission at constant pressure, adiabatic expansion to a lower pressure and

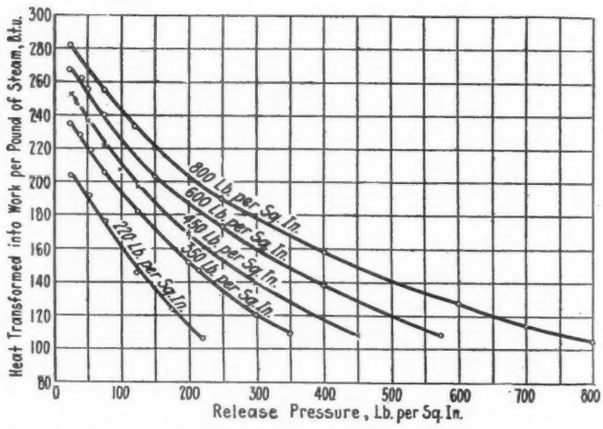

Heat Transformed into Work per Pound of Steam, B.t.u.
800 Lb. per Sq. In.
600 Lb. per Sq. In.
450 Lb. per Sq. In.
350 Lb. per Sq. In.
220 Lb. per Sq. In.
Release Pressure, Lb. per Sq. In.

Fig. 4—Relation between theoretical cylinder efficiency and release pressure for various steam pressures

(Exhaust in all cases against 25 lb. per sq. in. back pressure; admission temperature, 650 deg. F.)

exhaust at that pressure, constitutes the Rankine cycle. The amount of work developed can be found by a simpler method of calculation than that used above. It is only necessary to note that the steam has on admission a total energy of 1,338 B.t.u. and on exhaust 1,103 B.t.u., and that as expansion takes places adiabatically, without heat transfer between the steam and cylinder, the difference, 1,338—1,103=235 B.t.u. must be the energy transformed into work.

An indicator diagram constructed on the Rankine cycle gives the maximum amount of work which it is theoretically possible to extract from steam working between a given admission and a given exhaust pressure. It has however some disadvantages for locomotive work. For example, the steam in a locomotive cylinder is never expanded all the way down to the exhaust pressure. This condition may be approximated with a short cut-off and long expansion, but with a low ratio of expansion the Rankine cycle diagram is not in any way representative of the actual diagram. With an admission pressure of 350 lb. per sq. in. and expansion to 125 lb. per sq. in. the Rankine cycle dia-

[2]Mechanical Engineering, February, 1926, page 144.

gram would be *ABNVA*, Fig. 1, which owing to the high exhaust line would show less work than could be obtained with the lower exhaust line that would be found in practice. A better theoretical representation of practical conditions would be the locomotive cycle diagram *ABNPDA*.

The work developed in the locomotive cycle is easily calculated by the use of the steam tables. Take for example the diagram *ABEFDA*, representing admission at 350 lb. per sq. in., release at 50 lb. per sq. in., and exhaust at 25 lb. per sq. in. The area of this is *ABELA* with *LEFD* added. The former represents

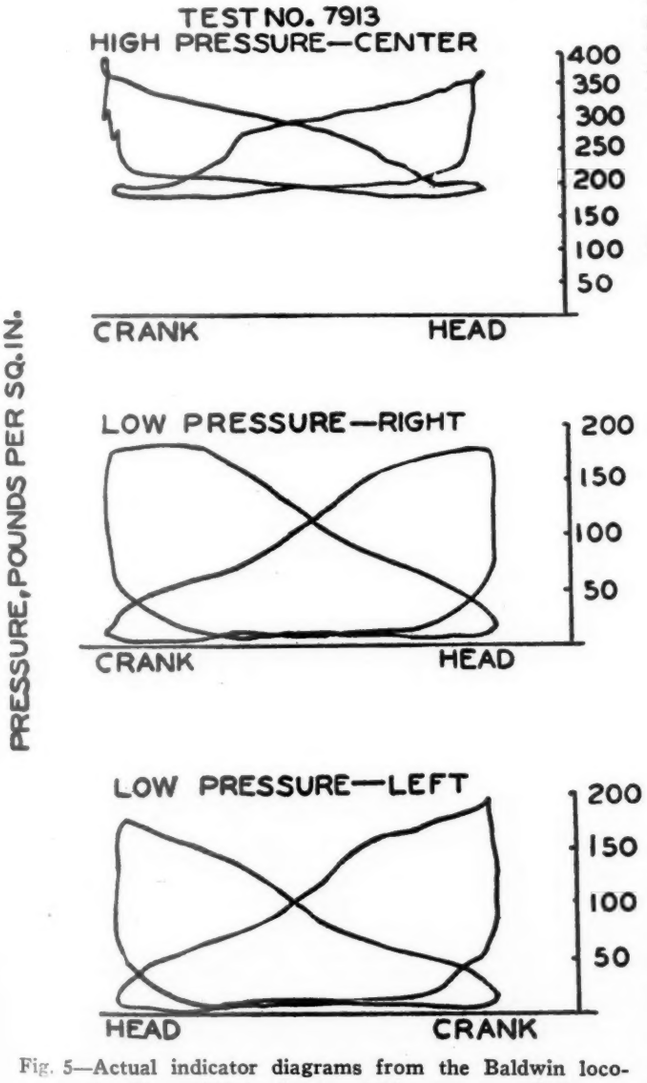


Fig. 5—Actual indicator diagrams from the Baldwin locomotive No. 60,000 having one high-pressure cylinder and two low-pressure cylinders

(Steam in branch pipes, 333 lb. per sq. in., 634 deg. F.; steam per i.hp.-hr., 14.2 lb.)

the work done in the Rankine cycle from 350 lb. per sq. in. to 50 lb. per sq. in. As the heat content is 1,338 B.t.u. at 350 lb. per sq. in., and 1,154 B.t.u. at 50 lb. per sq. in. the area *ABELA* represents 1,338=1,154=184 B.t.u. The area *LEFD* represents the product of the volume *LE*, in this case 8.30 cu. ft., multiplied by *EF*, the difference between the release pressure EM, 50 lb. per sq. in., and the exhaust pressure *FM*, 25 lb. per sq. in. Therefore the area *LEFD* represents 0.1852 x 8.30 x 25=37 B.t.u. Consequently the total work of the diagram *ABEFDA* is 184+37=221 B.t.u.

Expansion conditions of steam

By carrying out similar calculations for various release pressures with admission pressures of 800, 600, 450, 350 and 220 lb. per sq. in., the values given in column 7 of Table 1 are obtained.

This table consists of five panels, one for each of the admission pressures considered.

The figures show the effect of admission pressure and ratio of expansion on the thermal efficiency of the steam in the cylinders. For the first line in each panel the release pressure is the same as the admission pressure, so that there is no expansion, a rectangular full-stroke diagram, as *ABTDA* in Fig. 1, being obtained. Under

Table I—Expansion conditions of steam of 650 deg. F. expanded from 800, 600, 450, 350 and 220 lb. per sq. in. to various release pressures and then exhausted at 25 lb. per sq. in.

1 Admission pressure, lb. per sq. in.	2 Release pressure, lb. per sq. in.	3 Total heat at release per lb., B.t.u.	4 Quality at release deg. F. superheat	5 Volume at release cu. ft.	6 Number of expansions	7 Heat transformed to work per lb., B.t.u.	8 Thermal efficiency, per cent
1	2	3	4	5	6	7	8
800	800	1306	131.5	0.73	1.00	105	8.05
	700	1292	113	0.81	1.11	115	8.8
	600	1276	93	0.92	1.26	128	9.8
	400	1235	41	1.26	1.72	158	12.1
	250	1193	0.991	1.83	2.50	189	14.5
	150	1152	0.952	2.86	3.92	220	16.8
	75	1100	0.910	5.26	7.20	255	19.5
	50	1071	0.888	7.55	10.35	270	20.7
	25	1024	0.855	13.9	19.1	282	21.6
600	600	1320	163.5	1.01	1.00	108	8.1
	400	1277	105	1.38	1.37	139	10.5
	250	1230	45	1.99	1.97	173	13.1
	150	1186	0.992	2.98	2.95	203	15.4
	75	1131	0.945	5.46	5.40	240	18.2
	50	1101	0.921	7.85	7.78	255	19.3
	25	1052	0.885	14.4	14.3	268	20.3
450	450	1831	193.5	1.38	1.00	108	8.1
	300	1286	133	1.89	1.37	141	10.6
	200	1246	78	2.58	1.87	168	12.6
	100	1184	0.997	4.40	3.18	208	15.6
	75	1161	0.976	5.65	4.10	222	16.7
	50	1130	0.953	8.10	5.85	238	17.9
	25	1080	0.915	14.9	10.8	251	18.9
350	350	1338	218	1.80	1.00	109	8.1
	250	1298	163	2.33	1.31	137	10.2
	175	1262	113	3.07	1.70	161	12.0
	125	1231	70	3.99	2.21	181	13.5
	75	1186	9	5.89	3.26	206	15.4
	50	1154	0.978	8.30	4.60	222	16.6
	25	1103	0.940	15.3	8.49	235	17.5
220	220	1346	260	2.92	1.00	106	7.9
	175	1319	221	3.49	1.20	124	9.2
	125	1284	170	4.52	1.55	146	10.9
	75	1232	95	6.67	2.29	176	13.1
	50	1197	45	9.10	3.12	191	14.2
	25	1143	0.981	16.0	5.48	203	15.1

these conditions the work done is the external work of the steam entering the cylinder, less the work lost by exhausting against the back pressure of 25 lb. per sq. in. It will be seen that with this full-stroke cut-off the admission pressure has very little effect on the work done per pound of steam or on the thermal efficiency. The range is only from 105 to 109 B.t.u. per pound of steam and from 7.9 to 8.1 per cent thermal efficiency. Increase of the ratio of expansion gives an increase in efficiency which is more rapid with the higher admission pressures.

Relation between cylinder efficiency and expansion at various pressures

This is clearly shown in Fig. 2, in which the computed thermal efficiency of the cylinders is plotted against the ratio of expansion for each of the five admission pressures. Up to two expansions there is little perceptible difference in efficiency for pressures between 220 and 800 lb. per sq. in. Above this point the efficiency rises

faster with the higher pressures than with 220 lb. per sq. in., but nearly three expansions are reached before the difference between 350 and 800 lb. per sq. in. is noticeable.

The curves for each pressure are carried up to the degree of expansion at which the pressure is reduced to 25 lb. per sq. in. This is, of course, a greater expansion than is usually attainable in practice. If the steam conditions only are considered and the details of the cylinders and valve motion required for high expansion are neglected for the present, it may be taken as possible to expand the steam down to 50 lb. per sq. in. and then release to and expand at 25 lb. per sq. in. Under these conditions the figures shown in Table II

Table II—Effect of expanding one pound of steam adiabatically from various pressures

Admission temperature .....650 deg. F.
Release pressure ..... 50 lb. per sq. in.
Exhaust pressure ..... 25 lb. per sq. in.

1	2	3	4	5	6	7	8	9
Admission pressure, lb. per sq. in.	Volume at Cut-off, cu. ft.	Volume at Release, cu. ft.	Number of expansion	Heat transformed to work, B.t.u. per lb.	Thermal efficiency per cent	Relative efficiencies		
800	0.73	7.55	10.35	270	20.7	146	125	116
600	1.01	7.85	7.78	255	19.3	136	116	108
450	1.38	8.10	5.85	238	17.9	126	108	100
350	1.80	8.30	4.60	222	16.6	117	100	...
220	2.92	9.10	3.12	191	14.2	100	...	...

are obtained. To release at 50 lb. per sq. in., 3.12 expansions are required from 220 lb. per sq. in., 4.6 expansions from 350 lb. per sq. in., and so on up to 10.35 expansions for 800 lb. per sq. in.

The thermal efficiency in each case is shown in column 6. The values rise from 14.2 per cent with 220 lb. per

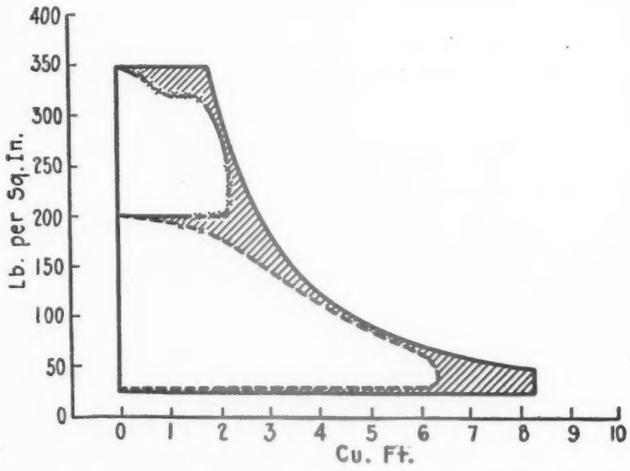


Fig. 6—Adiabatic expansion of steam from 350 lb. per sq. in., 650 deg. F., compared with actual cards from the Baldwin locomotive No. 60,000—Effect of clearance steam eliminated

(Work per pound of steam: Theoretical, 222 B.t.u.; actual, 174 B.t.u.; ratio, 78.5 per cent).

sq. in. to 17.9 per cent with 450 lb. per sq. in., and 20.7 per cent with 800 lb. per sq. in. These three values bear to each other, as shown in column 7, the relation of 100, 126, 146. That is to say, a rise of pressure of 230 lb. from 220 to 450 lb. per sq. in. raises the efficiency by 26 per cent of its value, while a further rise of 350 lb. from 450 to 800 lb. per sq. in. only adds another 20 per cent. That is to say, the higher the steam pressure the less it is possible to gain by a still further increase. The law of diminishing returns comes into operation. This statement is based only on theoretical thermo-dynamic considerations and does not take into account that as the pressure is increased the expansion must be lengthened, which will eventually introduce mechanical difficulties with cylinders and valve motion. In addition, each increase in boiler pressure tends

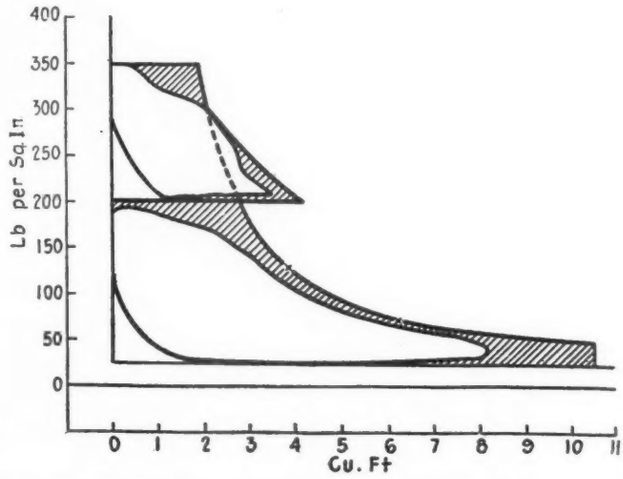


Fig. 7—Adiabatic expansion of steam from 350 lb. per sq. in. and 650 deg. F., compared with actual cards from the Baldwin locomotive No. 60,000—Effect of clearance steam included

to increase the boiler weight and to complicate the design. Taking all these matters into consideration it appears probable that for the present it will be found that the most economical pressure for construction, maintenance and operation will be found not to exceed 500 lb. per sq. in.

In order to help to visualize the effect of high admission pressures, diagrams corresponding to the conditions of Table II are plotted in Fig. 3 for 220, 350, 450

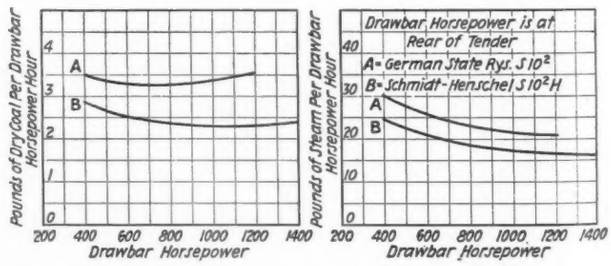


Fig 8—Water and fuel rate plotted against drawbar horsepower of the German State Railways 4-6-0 type before and after conversion to the double pressure design

and 800 lb. per sq. in. In Fig. 4 data from Table I are plotted above to show for the various admission pressures how the work developed per pound of steam in the locomotive cycle varies with the release pressure.

So far we have dealt with the theoretical expansion of the steam under ideal conditions. In Figs. 6 and 7 the diagram of the ideal locomotive cycle is compared with indicator diagrams taken from an actual locomotive. Fig. 5 reproduces indicator diagrams taken from a three-cylinder compound locomotive operating with a boiler pressure of 350 lb. per sq. in. gage. The three cylinders all have the same dimensions, 27 in. diameter by 32 in. stroke, and are compounded with one cylinder, high pressure and the other two, low pressure.

The low-pressure volume is therefore twice that of the high pressure. The broken-line diagram in Fig. 6 represents the high and low-pressure cards, with the effect of the clearance steam eliminated and with the low-pressure card drawn to a double scale horizontally. Around this is drawn in full lines the theoretical indicator diagram for the locomotive cycle with expansion to 50 lb. per sq. in. The shaded area between the actual and the theoretical cards represents losses by heat transfer between steam and cylinder and by friction in the ports. It will be noted that during admission there is a drop of pressure, but that before release takes place the expansion lines comes out to coincide very nearly with the thoretical line representing adiabatic expansion.

This shows that of the heat given up by the steam to the cylinder during admission a large part is returned to the steam during expansion, so that the actual pressure-volume curve does not drop so rapidly as does the adiabatic curve. The measured steam consumption during the test was 14.2 lb. per i. hp. hr., which corresponds to 174 B. t. u. transformed into work per pound of steam. The theoretical diagram shows 222 B. t. u. transformed per pound, so that the actual area is 78.5 per cent of the theoretical area. The actual ratio of expansion is from 1.8 cu. ft. to 6.4 cu. ft., or 3.6 expansions as against 4.6 expansions in the theoretical locomotive cycle.

Fig. 7 is similar to Fig. 6, except that here the effect of the clearance steam is shown. This shows that in order to provide for 3.6 expansions of the working steam the cylinder volume at the end of the stroke has to be 8.3 cu. ft. That is, the clearance steam makes it necessary to have 30 per cent more cylinder volume than is called for by the theoretical diagrams previously discussed. Consequently, to obtain high efficiency with the higher pressures it will be necessary to use even shorter cut-offs than are indicated by Tables I and II.

The pressure of 220 lb. per sq. in. absolute used in the calculations corresponds to a boiler pressure of 205 lb. per sq. in. gage. It is evidently possible to secure a considerable increase in the thermal efficiency of the cylinders by increasing the boiler pressure. To secure the full possible increase in efficiency the ratio of expansion must be increased. This can be done by the use of a special valve motion, or compound cylinders or both. The use of three cylinders makes compounding a very simple matter, and results obtained in practice are very satisfactory. Probably when everything is considered—construction, maintenance and operation—it will be found inexpedient for the present to use boiler pressures much over 450 lb. per sq. in. gage.

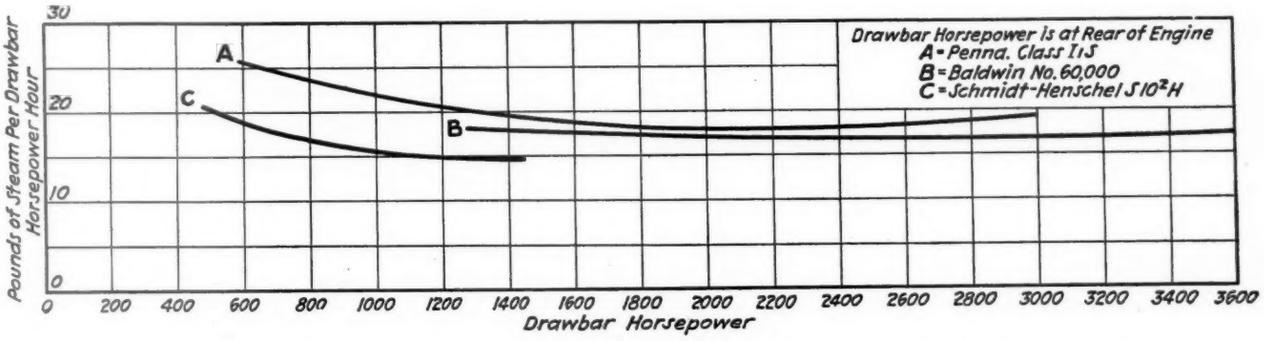


Fig. 9—Water rate plotted against drawbar horsepower for the Pennsylvania I1s, Baldwin No. 60,000 and Schmidt-Henschel locomotives

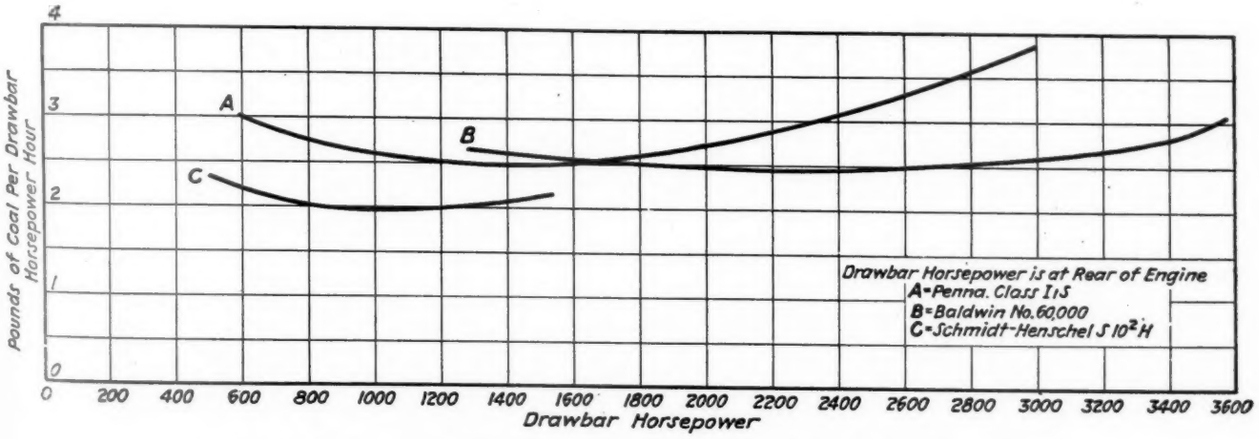


Fig. 10—Coal per drawbar horsepower plotted against drawbar horsepower

Discussion

In discussing Mr. Fry's suggested locomotive cycle, one of the speakers said that actual performance requires the use of a cycle factor which must take care of the equivalent ratio of expansion with a given clearance volume, the cooling or condensation effect of the steam during admission in the clearance space, wire drawing, throttling and a corresponding decrease of availability, the reheating factor which moves the expansion curve from adiabatic and the proper impression and its effect on the indicator card, etc. The same speaker also, in commenting on the statements relative

to the advantages in compounding, stated that with simple cylinders with increasing expansion ratios, the cut-off necessarily must be reduced to a point where the percentage of clearance volume to cut-off volume becomes so large that the loss due to cooling during admission offsets the gain due to expansion. This definitely limits the designer to given expansion ratios with simple cylinders. A further advantage, he said, of single cylinder expansion is the abnormal ratio of peak to mean piston load, if advantage is to be taken of better expansion ratios, which necessarily must go with an increase of pressure at low speeds. This requires heavier machinery at the expense of a smaller boiler with poor counterbalance conditions. On the other hand, he pointed out, compounding offers advantages in the use of greater expansion ratios which are needed to take care of the higher pressures.

H. B. Oatley, vice-president, Superheater Company, New York, presented a written discussion on Mr. Fry's paper in which he assumed a somewhat different type of boiler construction and that the maximum steam pressure may be raised, and probably can be raised with considerable gain. The following is an abstract of Mr. Oatley's written discussion:

The question of pressure must go along with the question of steam temperature and in the most advanced design of high pressure power stations the use of reheating or intermediate superheating is a factor of importance. It would have been very interesting if Mr. Fry had extended Table I to show the gain by reheating at 200 lb. or 250 lb. pressure in the first and second sections of this table.

The practical problem of reheating is, of course, far harder for the locomotive designer with the limited space available, than it is for the industrial plant de-

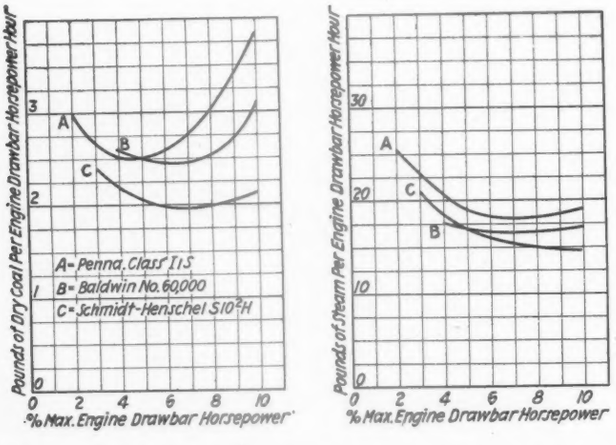


Fig. 11—Pounds of dry coal and steam per drawbar horsepower-hour plotted against drawbar horsepower, per cent

signer. The Schmidt-Henschel double-pressure locomotive on the German State Railways should impress one with the fact that an attempt has been made to provide what, in reality, is interstage reheating and at the same time to reach some of the economies which are to be found in the use of steam pressures which are being utilized in central power stations and industrial plants. This locomotive is of more than ordinary interest because of the marked advance toward higher steam pressures, carrying as it does a working pressure of between 850 to 900 lb. per sq. in., and also because of the double-pressure arrangement of the boiler. This method of steam generation has been provided, and reciprocating engines retained, in an effort to obtain a much more economical unit than any steam locomotive thus far used and to do this by means of a construction far less expensive, equally safe and practicable and more easily maintained than can be had by the use of an internal combustion or turbine prime power. Comparisons which will be shown include the performance of other locomotives working with what may be termed high steam

	German State Rys. 4-6-0 Type Normal Blr. S 10²	Schmidt-Henschel German St.Rys. 4-6-0 Type S 10² E	Penna. 2-10-0 Type I-1-S	Baldwin Loco.No. 60,000 4-10-2 Type
Working steam pressure, lb. per sq. in.	205	880 high 205 low	250	350
Dia. drivers, in.	77.95	77.95	62	63½
No. of cylinders	3	3	2	3
Dia. of cylinders, in.	19.7	1 h.p.-11.4 2 l.p.-19.7	30½	27
Stroke, in.	24.8	24.8	32	32
Maximum tractive force, lb.	(1) 32,200	33,400	90,000	82,500
Heating surface, Tubes and flues, sq.ft.	1,494	1,258	4,044	4,447
Heating surface, Firebox, sq.ft.	157.3	(2) 222	290	745
Heating surface, Total, sq. ft.	1,651	1,480	4,334	5,192
Superheating surface, sq. ft.	662	(3) 856	1,479	1,357
Grate area, sq.ft.	30.75	26.9	70.0	82.5
Type of superheater	A	Two - E	A	A

(1) Figured on 85 per cent boiler pressure for simple engine
(2) Figured on one-half the surface of water tubes
(3) For both superheaters

Table III—Comparison of a German State Railway's 4-6-0 type Pennsylvania I1s and the Baldwin No. 60,000 with the Schmidt-Henschel locomotive

pressures, which is to be understood as 250 lb. per sq. in. and upward.

The records of this locomotive support the thermal analysis of Mr. Fry. The steam pressures used, however, are above the limits set forth in his paper, but evidently Mr. Fry's limits as regards pressure are premised on the use of a single pressure generator and on the shell of the fire-tube boiler carrying the maximum pressure given to the high pressure cylinders.

The following data on the Schmidt-Henschel locomotive has been made available through the courtesy of R. P. Wagner, chief of the motive power division of the Deutsche-Reichsbahn, and S. Hoffman, managing director of the Schmidt'sche Heisedampf Gesellschaft, under whose direction the design was prepared. The tests were run on the Berlin-Magdeburg division of the German State Railways and dynamometer car records were used.

Table III gives a comparison of this locomotive as it originally existed—like which there are a large number in service, the Pennsylvania I1s class 2-10-0 type locomotive, and the Baldwin experimental 4-10-2 type locomotive No. 60,000.

Attention is invited to the fact that in point of size the double pressure locomotive is, in comparison with the two American built locomotives, a very small unit and it may reasonably be expected that had this experimental engine been of a size comparable with the modern American locomotive, that there would have been obtained a still lower fuel and water rate per unit of power developed.

Fig. 8 shows the water and fuel rate of the German locomotive plotted against drawbar horsepower before and after its conversion to the double pressure method of steam generation. The reduction in water and coal consumption through the change in boiler and cylinders

is clearly evidenced. In comparing these unit figures it must be kept in mind that the horsepower values are at the rear of the tender.

In Fig. 9 the water rate plotted against drawbar horsepower at the rear of the engine under test plant conditions is shown. Curve *A* shows the performance of the Pennsylvania I1s class 2-10-0 type locomotive, curve *B* of the Baldwin 4-10-2 type locomotive No. 60,000, and curve *C* of the double pressure locomotive on this basis. A remarkable reduction in steam consumption is clearly shown. It represents the advantages obtainable through the use of high pressure superheated steam delivered to a high pressure cylinder and steam of lower pressure, also superheated, delivered with the steam exhausted by the high pressure cylinder to the low pressure cylinders. The low pressure cylinders, therefore, are working with a much higher temperature than has hitherto been possible, except through impracticable temperature delivered to a high pressure cylinder.

Fig. 10 is on the same basis as Fig 9 and shows coal per drawbar horsepower-hour against drawbar horsepower. The same striking reduction in the fuel consumption per unit of power is noticeable. This is the result of the factors which have produced a reduction in steam consumption and also of the improved boiler performance which the design provides.

From the illustrations shown, the fact that the maximum horsepower of these locomotives was not directly comparable because of their difference in size, the relative performance at any given percentage of maximum power is not so clearly evident.

To bring this into a little clearer form, Fig. 11 has been prepared showing the steam and dry coal per drawbar horsepower-hour measured at the engine drawbar plotted against percentages of maximum locomotive capacity in terms of engine drawbar horsepower. These curves naturally bring the same percentage of power in the same vertical line, and are another way of illustrating the possibilities of further improvement in locomotive economy from a steam and fuel standpoint.

As was to have been expected, a number of difficulties were encountered in this first double-pressure locomotive, but all were of a relatively minor character and have been successfully overcome. Boiler feeding devices originally applied, were not entirely suitable. The means for indicating the water level required some modification. The performance of the locomotive showed that this system of steam generation and use was a perfectly satisfactory, safe and efficient design. It has been particularly noticeable that there have been no changes necessary in the method of handling the locomotive and that the engine crews have had no difficulty in adapting themselves to its operation. This is a factor of very great importance when considering new types of steam locomotives where internal combustion engines or turbines with various power transmission devices are utilized and where a very complicated and delicate condensing apparatus has to be used.

The results of these tests fell short of the expected best performance and some changes are now being made which are confidently expected to provide an additional 10 per cent in fuel economy.

I was given the opportunity of making a thorough inspection of this locomotive after the tests had been completed. This inspection confirmed the claims that have been made for the practicability of the Schmidt method of steam generation for locomotive service. The indirect method of steam generation utilized in this locomotive has been used for some time in power plants for stationary service. I visited two such power plants where the working steam pressure at the prime movers, which incidentally were reciprocating steam engines, was in excess of 50 atmospheres (735 lb. per sq. in.) Additional confirmation of the satisfactory operation of this type of steam generator was found.

The indirect method of steam generation offers advantages which may in part be described as follows:

1—The high pressure drum is not in direct contact with the high temperature gases.

2—The steam generation in the high pressure drum is uniformly distributed throughout the entire length of the drum. The separation of steam from water, therefore, is more evenly distributed and the so-called geyser action, found in normal boilers, is eliminated. The result is a smaller moisture content in the steam being taken from the high pressure boiler.

3—The circulation of water through the indirect heating system is influenced only by the temperature conditions ni the firebox. There is no opportunity for an unfavorable circulation caused by other conditions.

4—No stayed surfaces are used either in the indirect heating system or in the high pressure steam drum. The safety, therefore, of all parts carrying the high pressures is increased.

5—Firing up of a boiler with the indirect heating system can be done much more rapidly and with less stresing of the boiler material than with the usual type of steam generator.

6—The heating surfaces in the high pressure drum are practically scale free. In the high pressure drum there is no scale deposit since its feedwater is taken from the low pressure boiler where whatever scale forming material that is introduced remains. The cleaning of the high pressure boiler consists simply in washing out any soft sludge which may accumulate. The indirect heating system is a closed circuit and uses water which is scale and corrosion free.

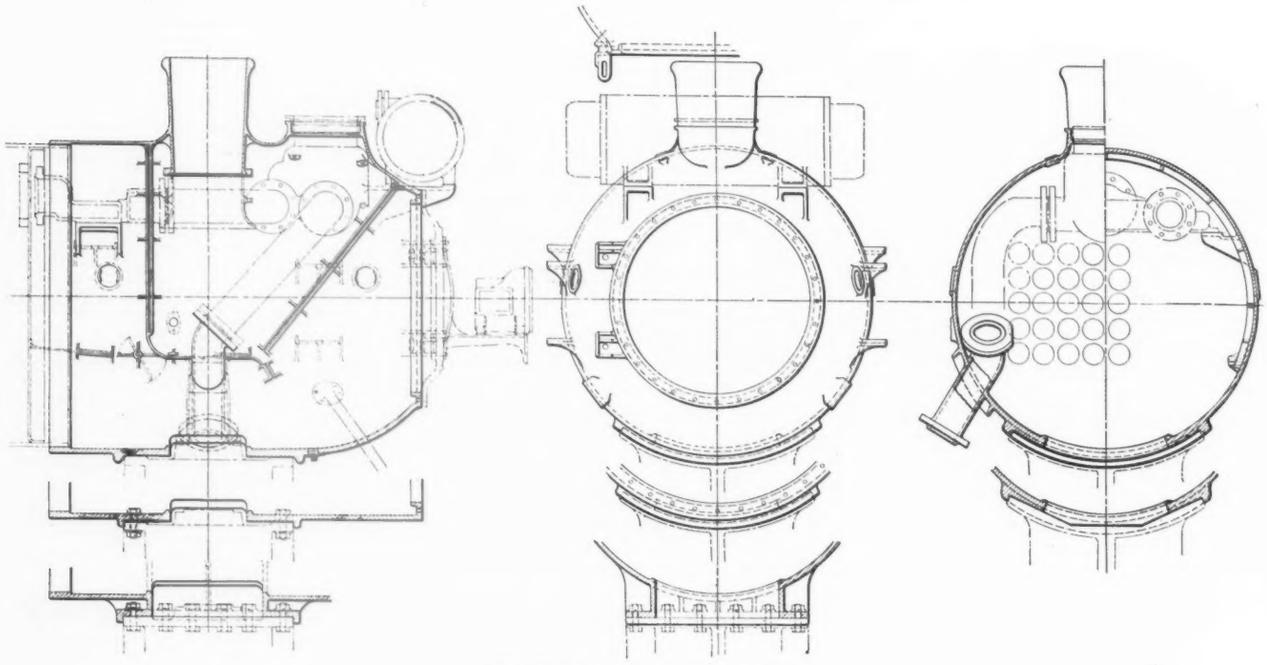
Smokebox prevents air leaks

Deflector plates and spark netting tongued and grooved to eliminate bolts—Front end a steel casting

IN the locomotive smokebox in common use there are numerous openings that, if not properly closed, will eventually cause air leaks. Thus, if the saddle bolts, front door bolts, or any of the bolts that fasten auxiliary parts inside or outside of the smokebox, are not tight, or if the packing around the steam pipes where they pass into the smokebox is not tight, air leaks will occur. Going inside the smokebox, it is always a rather difficult job to remove the spark netting and deflector plates owing to the corroding effect of the smokebox gases on the bolts, nuts and keys required to hold the parts in place. The construction of the present smokebox also readily lends itself to air leaks owing to the fact that the gases quickly eat away the smokebox liner to which the cylinder saddle is fastened.

In an effort to eliminate air leaks, to reduce to a minimum the number of parts in the smokebox, to counteract as far as possible the effects of smokebox gases and to reduce the maintenance costs, W. L. Bean, mechanical manager, New York, New Haven & Hart-

ford, has patented a smokebox which has been in service on locomotive No. 1,370 for a period of six months. The same design of front end has been included in ten

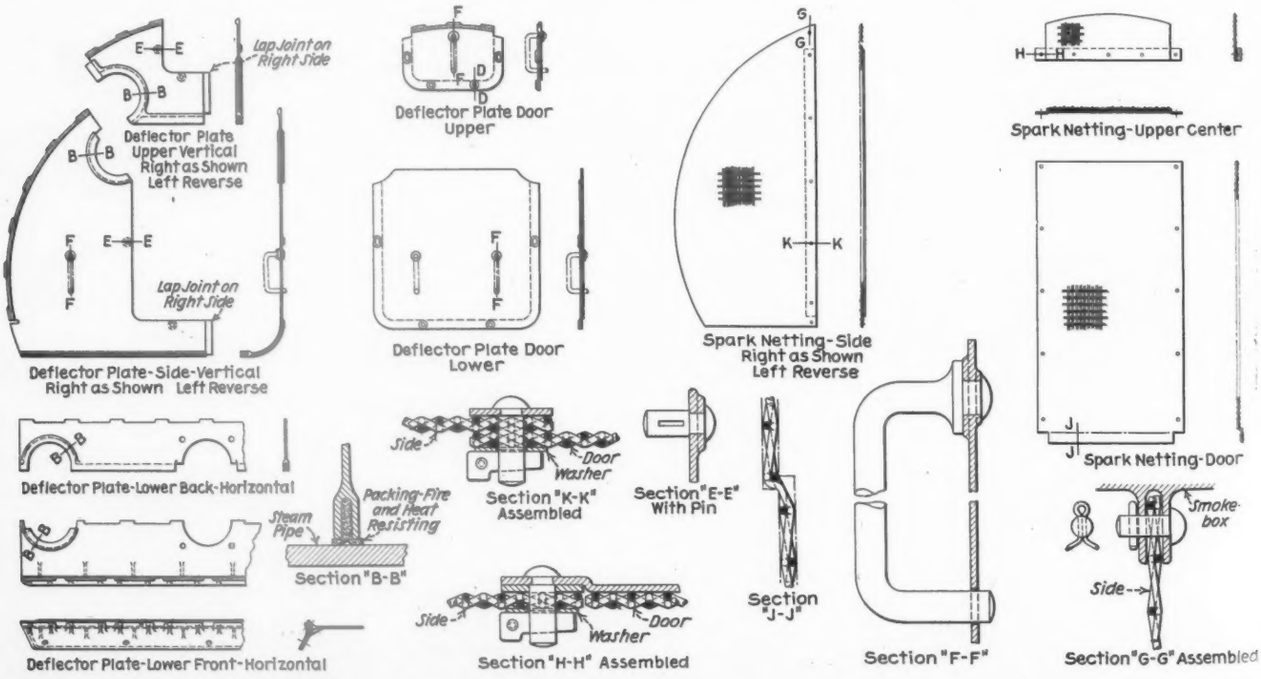


The Bean cast steel smokebox

Mountain Type locomotives now being built for the New Haven by the American Locomotive Company.

The design of the smokebox

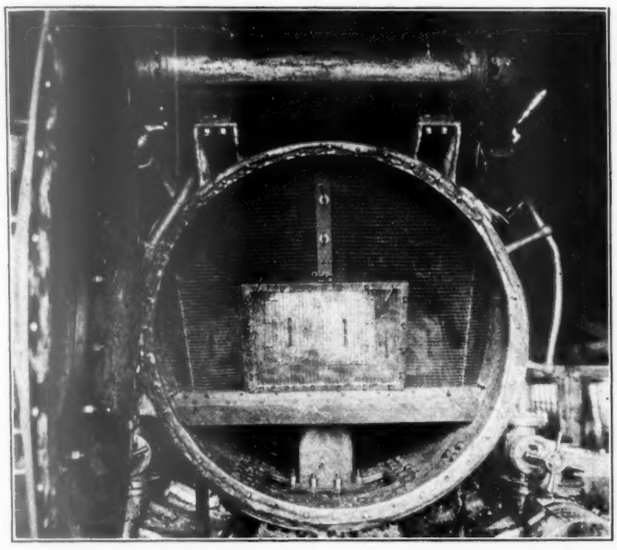
The smokebox is an integral steel casting, wherein are combined on the outside all auxiliary parts, such as steps, steam pipe flanges, feed water heater brackets, support for an outside throttle, smokebox brace lugs and Okadee front door hinges. The forward end of the smokebox casting is designed with a bullet nose form, the purpose of which is to remove the corner pocket for cinders, which often become incandescent due to false drafts, thus eventually burning out the bottom of the front door. The extent to which this curvature of the smokebox is carried is dependent on the clearance required through the front end for the removal of the lower rows of superheater units and flues. Furthermore, the surface of the steel casting is more resistive to the abrasive action of the cinders, thus prolonging the life of the parts subjected to this wear and thereby eliminating a possible air leak.



The deflector plates and spark netting parts used in the Bean smokebox

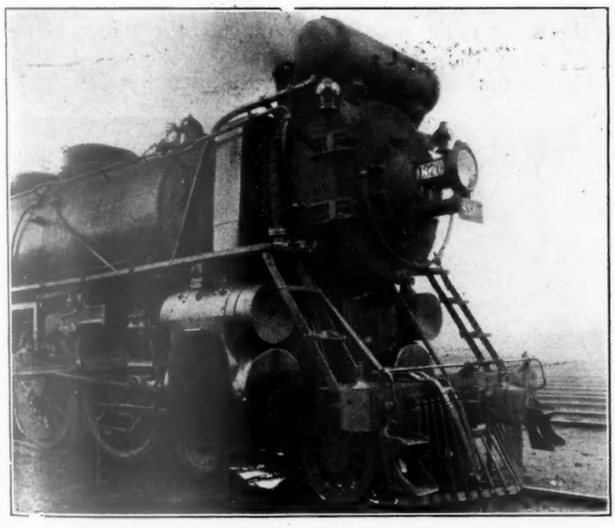
Curved type saddle fit

As shown in the drawing, the saddle fit of the smokebox is designed to meet various conditions. Owing to the fact that locomotive No. 1,370 had already been built, the curved type of saddle fit had to be used, and the saddle bolts pass into the smokebox. When the



Spark netting in place ready to close the front door which swings on hinges cast integral with the smokebox

smokebox is applied to new locomotives the bottom of the smokebox and the cylinder saddle will be cast flat and will be located a sufficient distance from the outside diameter of the smokebox so that the saddle bolts can be applied without entering the front end. This feature will eliminate the possibility of air leaks and leaky

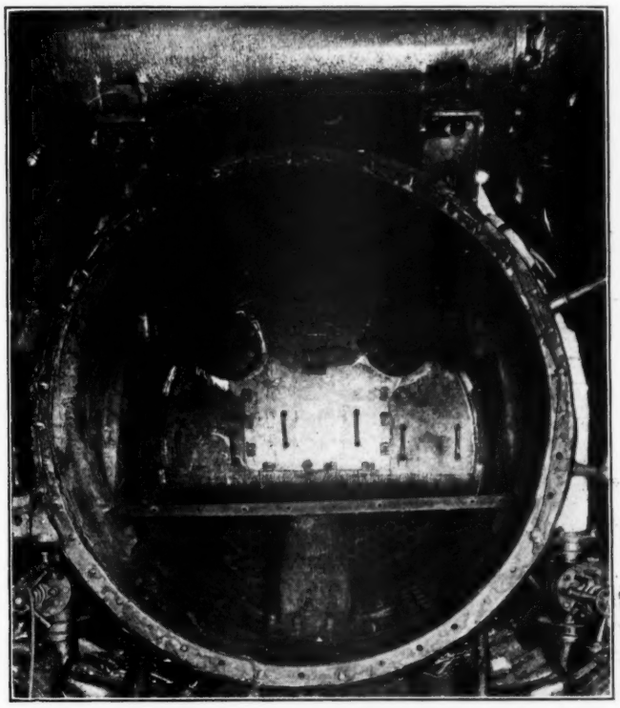


A N. Y. N. H. & H. Pacific type locomotive equipped with a Bean smokebox

steam pipes caused by loose saddle bolts. The saddle fit is cast with four lips that snugly fit the edges of the saddle, thus relieving the saddle bolts of some of the shearing action imposed on them. The flat saddle fit can be accurately machined, which cannot be done by the chipping method.

The superheater header pads, inside steampipe flanges, and deflector plate and spark netting grooves are cast integral with the inside of the smokebox. Of particular interest is the quick and secure manner in which the deflector plates and spark netting can be applied. First, the left and right upper vertical deflector plates are slid into the proper grooves. Next, the upper deflector plate door is slid in position which fits over four pins provided with slots to receive flat taper keys. Then the left and right side vertical deflector plates are fitted into the proper grooves. As shown in the drawing, with these plates in position, an accurate fit is made around the top of the two steam pipes. Pieces of asbestos are placed in the grooves, formed in the deflector plates, thus making the flange fits spark tight. Next, the lower deflector door plate is locked in position by a design of pin shown at section *E-E*. The purpose of this design is to make the pin air tight.

With the lower door in position, the vertical deflector plates are securely locked in position. Next, the



The inside of the Bean smokebox showing the deflector plates in place and the inside steam pipe flanges cast integral with the front end

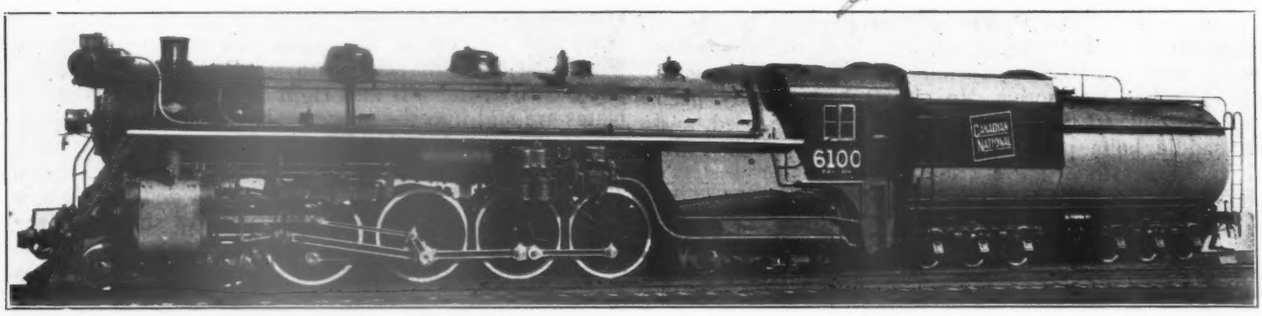
lower back horizontal deflector plate is placed in position, after which the front deflector plate is placed.

These two pieces form the lower plate or table. They are fastened under the exhaust nozzle by four bolts that support the nozzle.

The front lower deflector plate is provided with a groove for receiving the spark netting and also with an adjustable damper plate. The netting is applied in somewhat the same manner as are the deflector plates. The left and right sections of the spark netting are pushed into the grooves. The spark door is applied.

The bottom edge of the spark netting door is offset to slip into the groove located in the lower front horizontal deflector plate.

After six months' service on locomotive No. 1,370, there are no front end air leaks, which has effected a saving in fuel consumption; there has been a reduction in smokebox maintenance; and no burning of the front ends and door such as may be caused by a pocket of hot cinders.

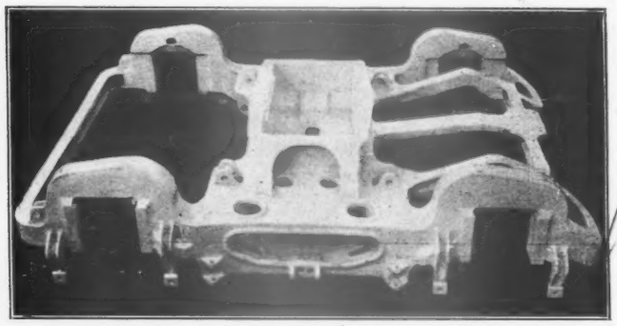


The first Canadian National 4-8-4 type locomotive

Canadian National buys 4-8-4 type locomotives

Floating bushing bearings on main driver and truck journals—Boilers of silicon steel

FORTY 4-8-4 type locomotives have been ordered and are now being delivered to the Canadian National by locomotive builders in Canada, 20 of which are being built by the Canadian Locomotive Company, Kingston, Ont., and 20 by the Montreal Locomotive Works. An additional 12 locomotives of this type are also being built by the American Locomotive Company in the United States for use on the Grand Trunk Western. These locomotives, which the railroad will designate the Northern type, will be used between Montreal, Que., and Sarnia, Ont., in passenger and manifest freight service, while the 12 locomotives on the Grand Trunk Western will be used in similar service between Sarnia and Chicago. It is intended to use them on extended runs over two or more regular divisions.



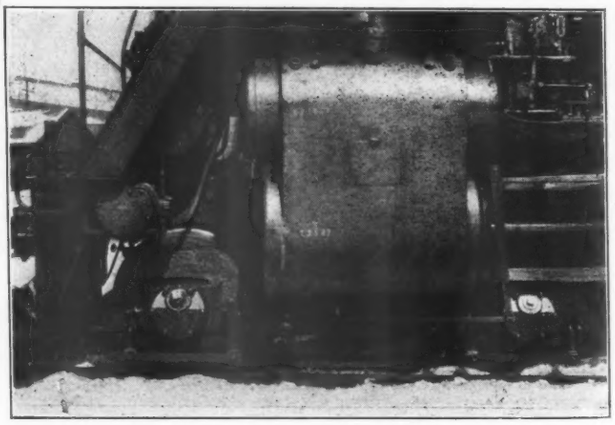
The frame casting for the outside journal box engine truck

The first of these locomotives was delivered by the Canadian Locomotive Company during the first week in June, and it was on exhibit at the Bonaventure passenger station of the Canadian National Railways, Montreal, during the convention of the Mechanical Division of the American Railway Association, June 7 to 10, inclusive.

There are several features of unusual interest in these locomotives, the two most important of which are the use of special steel in the boiler to permit raising the boiler pressure without materially increasing the weight, and the other is a floating bushing main driving box, the design of which departs radically from the customary crown brass type.

The shell courses of the boiler are made of a high tensile silicon steel developed by the Carnegie Steel Company and having a tensile strength ranging between 70,000 and 83,000 lb. and a minimum yield point of 38,000 lb. Silicon is the principal factor employed in obtaining the high elastic limit and the high ductility characteristics of this steel. While certain manufacturing problems, including the addition of the necessary silicon, result in an added cost of making the silicon steel, there is no mystery in the process. It can be made by the usual basic open-hearth method, the silicon being added while the steel is being tapped.

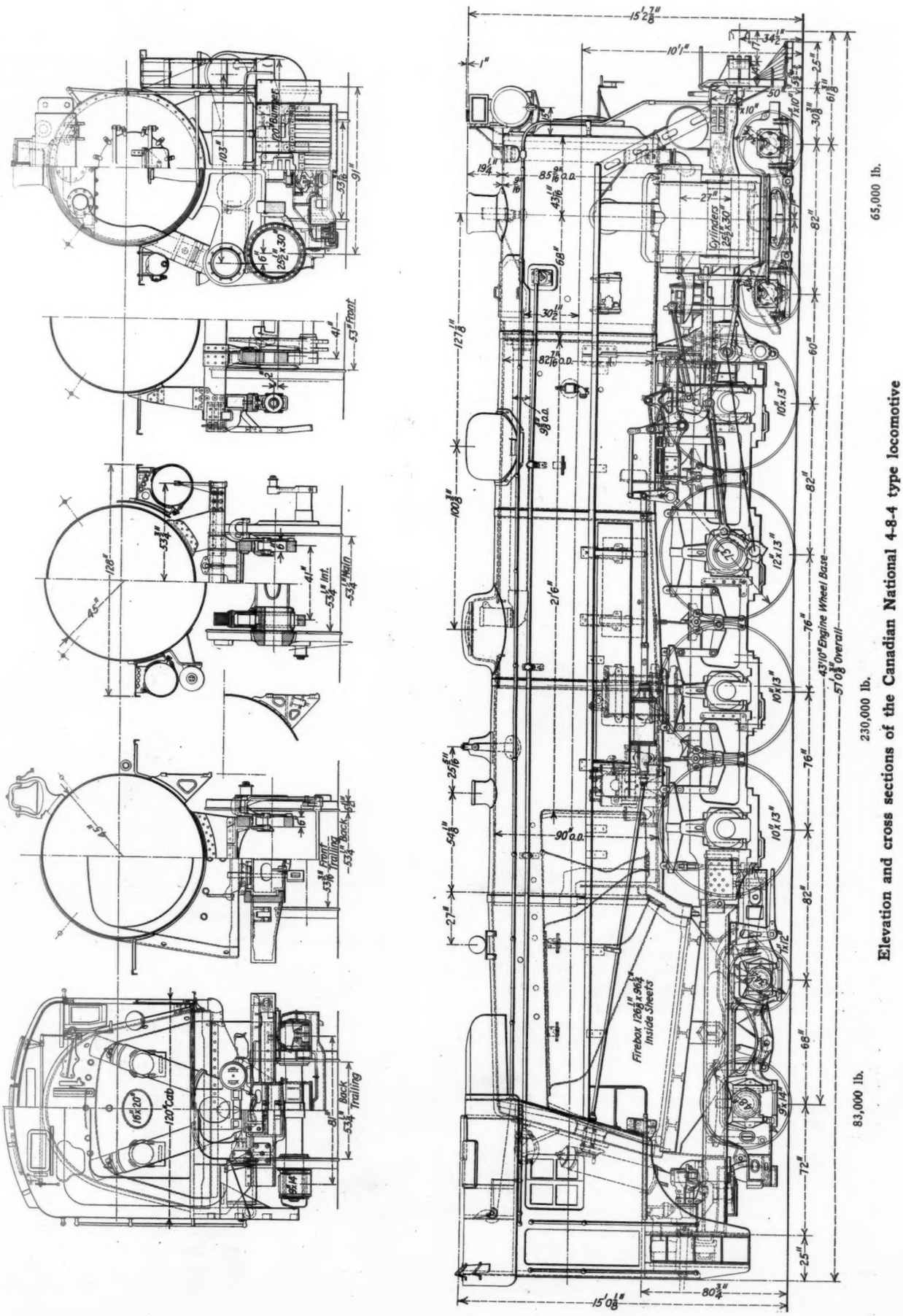
The minimum tensile strength specified for the Canadian National boiler plates is 10,000 lb. less than the mill's standard grade of silicon steel and its carbon and silicon limits are slightly lower. The average results of 350 tests are as follows:



The engine truck, equipped with floating bushing journal boxes

Tensile strength	76,811 lb.
Yield point	46,146 lb.
Elongation	25.2 per cent
Reduction in area	47.1 per cent

The use of this steel permitted the construction of the

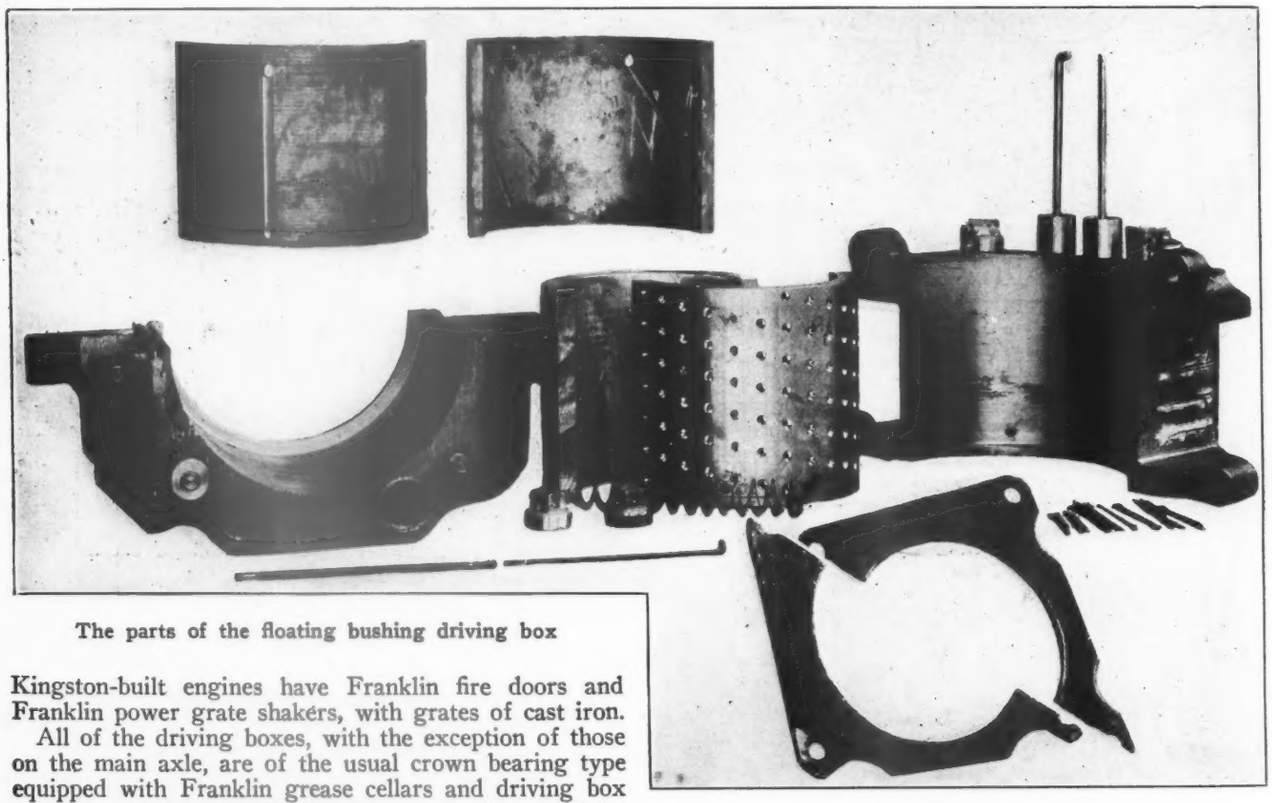


Elevation and cross sections of the Canadian National 4-8-4 type locomotive

barrel of the boiler to carry a steam pressure of 250 lb. with no added weight as compared with a similar boiler of carbon steel plates to carry 200 lb. pressure.

The boiler is of the straight top type, with a radial stayed firebox. Steel staybolts are used throughout and the flexible bolts are of the F.B.C. welded telltale type. The tube sheet layout is designed for the Type E superheater with 177 3½-in. flues and 27 2¼-in. tubes. Superheater units are included in 162 of the 3½-in. flues. The firebox has a grate area of 84.4 sq. ft. and a combustion chamber extends 48½ in. into the barrel. The brick arch is carried on three 3-in. arch tubes and two Nicholson thermic syphons. An additional syphon is located in the combustion chamber.

All of the engines are equipped with type D1 Duplex stokers and Elesco type K-39 feedwater heaters, with the C.F. pumps. American multiple throttles are also used on all of the locomotives. The engines built at Montreal are equipped with the Shoemaker fire doors and with cast steel grates, without power grate shakers. The Kingston-built engines have Franklin fire doors and Franklin power grate shakers, with grates of cast iron.



The parts of the floating bushing driving box

All of the driving boxes, with the exception of those on the main axle, are of the usual crown bearing type equipped with Franklin grease cellars and driving box spreaders. The main driving boxes are of a novel design which has been developed on the Canadian National and the Grand Trunk Western and which, prior to the building of the new locomotives, has been applied to the main drivers of a number of engines in both freight and passenger service. The results obtained in service from the operation of these boxes have been so satisfactory that these boxes are being applied on the main drivers of the entire lot of 52 new 4-8-4 type locomotives being built in Canada and the United States.

As shown in the illustration, the box* is made of cast steel in two sections, parted horizontally and held together by four bolts of high tensile steel, 1⅜ in. in diameter. Two eyebolts are screwed into the top half of the box for convenience in lifting it off. A high grade iron bushing is keyed into the cast steel box and the brass floating bushing revolves between the journal and the iron bushing in the driving box. The bushings are both made in two pieces so that they may be removed if necessary without dropping the wheel. A ½-in. steel plate in the inside face of the box holds the bushing in place. The box is lubricated by the ordinary driving journal compound which is supplied to the bearing from four pockets, two at the top and two at the bottom of the box. The grease is carried from the pockets through holes and grooves in the iron bushing to the inner brass bearings. The brass bushing contains a large number of ¼-in. holes countersunk on the outside and full of grease. The grease from the two top pockets feeds the bearings when softened, but on the two bottom pockets a plunger is applied with a coil spring which will put some pressure on the grease and assist in feeding it. The grease pockets open on the inside face of the box and are each equipped with a plug. These plugs when screwed in are locked in pairs by two rods, each of which passes through two of the plugs. It is said to be a small job to remove these grease pocket plugs and fill the pockets with grease.

The life of the floating bushing for the driving boxes has not yet been fully determined. One engine, however, has made 40,000 miles with only 1/64 in. wear and it is expected to run from shopping to shopping. Another engine has made 25,000 miles with only three or four thousandths of an inch wear. If, however, the wear develops to such an extent that it becomes necessary to change the bushings, this becomes a roundhouse job which, it is said, can be done in one hour. Tapped holes are provided in the inside face of the floating bushing to facilitate its removal.

This design of box has eliminated pounding and has reduced to a very noticeable extent the amount of maintenance required on rods and has also provided a much larger continuous hub area than the conventional box design. The boxes are said to have run large mileages

*This type of driving and truck box, covered by patents pending, is being manufactured in the United States by the Locomotive Finished Material Company, Atchison, Kans.—EDITOR.

on one packing of grease and the cost of lubrication is very low.

The front drivers are equipped with lateral motion devices, the Franklin type being applied on the Kingston-built locomotives and the Alco type on the Montreal-built locomotives. An interesting detail in the building of the locomotives is that all the axle journals are finished by grinding.

Another interesting feature in these locomotives is the four-wheel outside bearing engine truck. The journal boxes of this truck are also of the floating bushing type. Although they differ in construction from the main driving box, they are built on the same principle. The boxes for the truck are one-piece castings of Vanadium steel in which a bushing of high grade hard iron is pressed and between which and the journal the hard bronze bushing floats. A removable collar on the end of the axle holds the bearing in place and at the same time by its lateral movement pumps grease into the bearing. Space is provided for the grease inside the cover which is bolted on the outside face of the box. The cover contains a removable plug for applying the grease. A ⅜-in. bronze liner is applied on the inside face of the box and between this bronze liner and the inner end of the floating bushing, which in the truck boxes is a solid bushing, a felt ring in a brass container is applied to hold the grease in the box.

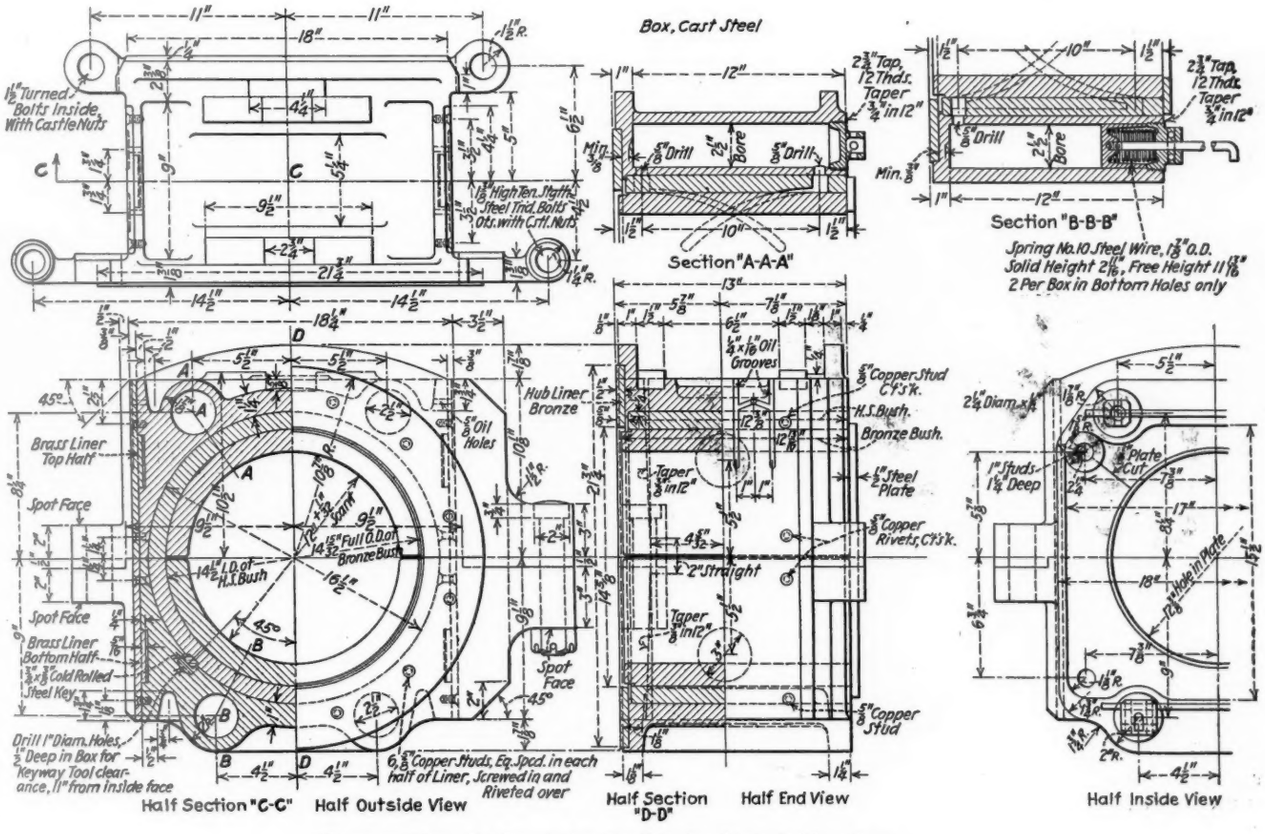
The spring arrangement on this truck is unusual. There are three semi-elliptic springs on each side, the center one acting as an equalizer while each of the other two is hung in the box in a spring seat which is cast integral with the box. The truck frame, with the bolster and the lateral resistance device is of Commonwealth design.

Three engine trucks of this design were applied to Canadian National 4-8-2 type locomotives, one of which has now been in service three years and the other two about nine months each. A fourth truck of this type was applied to a Grand Trunk 4-6-2 type locomotive. This has been in service about one year. These trucks have all shown a remarkable freedom from hot box troubles and have reduced the usual maintenance costs due to changing wheels, brasses, etc., and the packing of cellars. The grease used is similar to rod cup grease, but with a lower melting point. The wear on the bronze bearings is very slight and their life is estimated at 100,000 miles. A four-wheel truck with inside journals and floating bushing journal boxes similar to those on the main drivers is also in service on the Canadian National and giving good results. This design has been developed for application to the journals of existing engine trucks.

The trailing truck is of the Commonwealth four-wheel design with steel tired wheels 34¼ in. in diameter on the front axle, and 48 in. in diameter on the rear axle. The front axle has a total lateral of 1¼ in., while the rear axle the lateral is ⅜ in. The boxes on the trailer journals are also of the floating bushing type, grease lubricated.

Boosters are being applied to ten of the twenty locomotives which are being built at Kingston, but all of the trailing trucks are arranged so that boosters may be applied later. The design of the boxes and bearings of the trailer journals is essentially the same as those on the engine truck with the exception that the grease retaining rings are of bronze instead of felt.

The cylinders are of cast iron with Hunt-Spiller bushings for the cylinders and valve chests. The pistons, which are of the Canadian National standard built-up type, are also fitted with Hunt-Spiller bull rings. The


Box, Cast Steel
Section "A-A-A"
Section "B-B-B"
Spring No.10 Steel Wire, 1⅜" O.D. Solid Height 2 1/16", Free Height 11 15/16" 2 Per Box in Bottom Holes only
Half Section "C-C"
Half Outside View
Half Section "D-D"
Half End View
Half Inside View

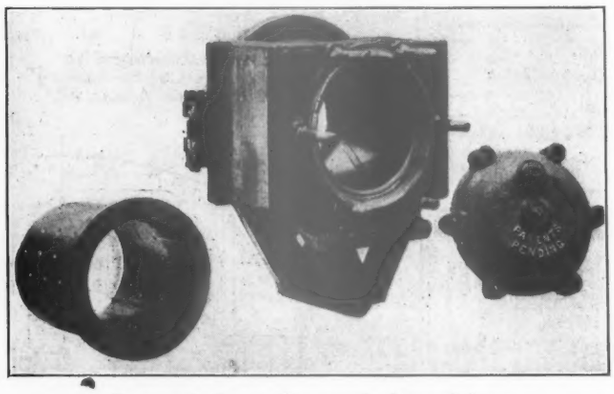
Construction details of the floating bushing driving box

back end of the main rod and the intermediate side rods are equipped with floating bushing bearings. The locomotives are equipped with Precision reverse gears and with Baker valve gear which give a maximum travel in forward motion of 9 in. The cylinders are lubricated by the Nathan mechanical type lubricator of 16 pints capacity, suitable for long runs. The auxiliaries are lubricated with Detroit hydrostatic lubricators, with three or four feeds, depending on whether or not the locomotives are equipped with boosters.

Special steels are used in the construction of the locomotives in a number of other details besides the boiler shell.

The main frames for both orders are half of nickel steel and half of Vanadium steel. The main axles, main crank pins, side and main rods and piston rods are all of nickel steel. Carbon steel is used for the springs, with the exception of the engine truck springs, which are of silico-manganese steel.

The cab is a short vestibule type of steel, wood lined. The turrets are located ahead of the cab. The left hand turret is supplied with superheated steam by a 3-in. pipe leading from a connection on the superheater header, while the right-hand turret is supplied with saturated steam from a direct connection to the boiler. Superheated steam is supplied to the air pump, feedwater



Parts of the engine truck journal box

heater pump, stoker and headlight generator, while saturated steam is supplied to steam heat line, inspirator, lubricator and other small auxiliaries.

The four-chime whistle is located on the left side of the smokebox near the stack, with a 1-in. connection to the superheated steam line from the header, and is operated by a wire cable carried through the handrail on the left side. Two blow-off valves are located on the right hand side of the firebox and can be operated in unison from the cab. Both blow-off cocks are connected to an L. & C. sludge remover. One has an internal pipe connection along the bottom of the barrel extending to within 2 ft. of the front tube sheet, while the other has a pipe connection across the throat with an opening opposite the side water legs. The side checks carry the feedwater through troughs on the inside of the barrel down near the bottom of the tubes so as to prevent deposits gathering on top of the tubes.

The front end is fitted with C. N. standard barrel netting and the exhaust tip is a steel insert in the end of the exhaust stand. The smokebox front is of pressed steel with a cast iron door. A Barco blower connection is applied on the left side of the smokebox.

A new feature has been introduced on these locomotives by the use of a common exhaust pipe on the left side for the air pump, feedwater heater pump and stoker. This pipe is carried forward to a tee in the exhaust steam pipe leading from the exhaust passage in the cylinder side to the feedwater heater located on the top of the smokebox. In the locomotives equipped with boosters, the exhaust from the booster is carried along the right side of the engine and into a tee in the right-hand exhaust pipe leading from the cylinder to the feedwater heater. A special Crane check valve is applied to the booster exhaust line.

Among other special equipment is an Ashcroft cut-off control gage, and Huron arch tube and washout plugs. Cardwell draft gears are applied to the Kingston-built engines and Miner draft gears to the Montreal-built engines. The locomotives are all equipped with 8½-in. cross-compound compressors.

The tender frames are Commonwealth castings, while the tanks are of the Vanderbilt type. The tenders are carried on Commonwealth steel trucks, with 6-in. by 11-in. journals with 34¼-in. steel tired wheels.

Departure has been made from the use of the customary black in the exterior finish of the locomotive. The boiler jackets of these locomotives are painted a dark gray.

The table gives the principal dimensions, weights and proportions of the 4-8-4 type locomotives.

Principal dimensions, weights and proportions of the Canadian National 4-8-4 locomotive

Railroad	Canadian National	
Type of locomotive	4-8-4	
Service	Pass. and manifest frt.	
Cylinders, diameter and stroke	25½ in. by 30 in.	
Valve gear, type	Baker	
Valves, piston type, size	14 in.	
Maximum travel	9 in.	
Lap	1 1/16 in.	
Exhaust clearance	1/4 in.	
Lead	1/4 in.	
Weights in working order:	With booster	Without booster
On drivers	232,000 lb.	230,000 lb.
On front truck	65,000 lb.	65,000 lb.
On trailing truck	91,000 lb.	83,000 lb.
Total engine	388,000 lb.	378,000 lb.
Tender	260,000 lb.	260,000 lb.
Wheel bases:		
Driving	19 ft. 6 in.	
Total engine	43 ft. 10 in.	
Total engine and tender	82 ft. 0 in.	
Wheels, diameter outside tires:		
Driving	73 in.	
Front truck	34¼ in.	
Trailing truck	34½ in., front; 48 in., rear	
Journals, diameter and length:		
Driving, main	12 in. by 13 in.	
Driving, others	10 in. by 13 in.	
Engine truck	7 in. by 10 in.	
Trailing truck	7 in. by 12 in., front; 9 in. by 14 in., rear	
Boiler:		
Type	Straight top	
Steam pressure	250 lb.	
Fuel, kind	Bit. coal	
Diameter, first ring, inside	80⅞ in.	
Diameter, largest course, outside	90 in.	
Firebox, length and width	126⅛ in. by 96¼ in.	
Arch tubes, number and diameter	3—3 in.; 2 syphons	
Combustion chamber length	48½ in.	
Tubes, number and diameter	27—2¼ in.; 15—3½ in.	
Flues, number and diameter	162—3½ in.	
Length over tube sheets	21 ft. 6 in.	
Grate area	84.4 sq. ft.	
Heating surfaces:		
Firebox and comb. chamber	315 sq. ft.	
Arch tubes and syphons	117 sq. ft.	
Tubes and flues	3,814 sq. ft.	
Total evaporative	4,256 sq. ft.	
Superheating	1,700 sq. ft.	
Comb. evaporative and superheating	5,956 sq. ft.	
Tender:		
Style	Vanderbilt	
Water capacity	11,300 Imp. gal.	
Fuel capacity	20 tons	
General data estimated:		
Rated tractive force, engine	56,800 lb.	
Rated tractive force, engine and booster	67,700 lb.	
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	60	
Weight on drivers ÷ tractive force	4.05	
Total weight engine ÷ comb. heat. surface	64	
Boiler proportions:		
Tractive force ÷ comb. heat. surface	9.54	
Tractive force × dia. drivers ÷ comb. heat. surface	695	
Firebox heat. surface ÷ grate area	5.12	
Firebox heat. surface, per cent of evap. heat. surface	10.1	
Superheat. surface, per cent of evap. heat. surface	40	

A new undertaking in apprentice training

Part 1—Some of the more important features and certain observations of the plans used on the Baltimore & Ohio and the Missouri Pacific

By Hayes Robbins

Formerly assistant to the president of the Boston & Maine. Author of "Human Relations in Railroading"

PROGRESS of the new plan of apprentice training in effect since last fall on the Baltimore & Ohio and the Missouri Pacific, in co-operation with the Railway Educational Bureau, is being watched with interest because it represents a distinct departure from methods thus far pursued on other roads.

The experiment has proceeded far enough to disclose some significant angles and to justify a description of the procedure and early experiences, for such light as they may throw on the points of chief concern to executives interested in the problem.

Briefly, the two outstanding points of difference or distinction are: (a) the new plan operates through lessons by mail, supplemented by correspondence and periodical visits of traveling instructors, instead of through shop classes at given points; (b) every apprentice at whatever point employed is required to pursue the work as a condition of his retention in the service; failure to do so with reasonable proficiency eliminates him after a given period, unless after due hearing his delinquencies are promptly made up or time extension is granted for proper cause. Many other differences in procedure grow out of these fundamentals.

Impressions gained from interviews with apprentices, supervisors and departmental officials on a brief visit to certain points on the two railroads, and to the headquarters of the Railway Educational Bureau* in Omaha, are recorded here for whatever interest they may have to railroad men who are giving particular thought to the problem of building up, not alone traffic and facilities, but men, equal to the requirements of railroading of the future. The experiment testifies at least to a growing recognition that the problem for tomorrow is not the same as that of yesterday. A skilled and competent working force is to become a more rather than less important factor in unit costs and operating ratios. Furthermore, to attract and retain such a force railroads and industries alike are already competing and will necessarily compete for the most desired type of young men with the increasing number of managements in both fields which do provide opportunity for technical and craft training within their own organizations.

Scope and procedure

Before attempting to describe what has been happening in the first eight months of the new plan there should be set down a statement of its scope and procedure.

A progressive series of lessons prepared by the Bureau is sent, one at a time, to each apprentice at his home address. This is preceded by an introductory explanation, to which the boy replies with a "get-acquainted" letter in his own handwriting. In this he answers such questions as the extent of his schooling, what most interested him in his school work, how long he has been an apprentice, what led him to take up his present trade and what part of it he likes best. At the same time a test sheet in simple arithmetic determines whether the apprentice is ready to start his work in mathematics with fractions or desires to "begin at the beginning." The intent is that if his early education has been deficient, or he has been long out of school and needs to "brush up," he shall make sure of his groundwork before proceeding farther.

On a basis of two lessons a month the instruction is planned to cover a four-year period. The answers are returned to Bureau headquarters and there examined, graded, and returned to the pupil within two days as a rule, with corrections and with pencilled explanations of points which he appears not to understand. With this goes a card showing the grading accorded to his paper, if it is 75 per cent or above. If it is below that mark, the boy gets a personal letter from his office instructor, explaining in detail his mistakes with suggestions on how to overcome them. A copy of this letter goes to the traveling apprentice instructor.

Boys who fail to send in papers regularly or who show a grading of less than 75 per cent, or otherwise give evidence of unusual difficulty with their work or some particular part of it, are visited and given individual help by one of the traveling instructors, to whom the names are sent as the cases arise, and who in turn submit daily reports. There are at present three such instructors on each road, assigned to territorial districts, besides a system supervisor. Sometimes the boys are seen in rotation in the shop office at times when they can best be spared, by arrangement with the local supervision, or after working hours; occasionally at their own homes, where contact is made with the parents.

The method of general supervision of the work is slightly different on the Baltimore & Ohio from that on the Missouri Pacific. In both cases the head of the mechanical department is the ultimate directing authority and in both cases the traveling instructors are salaried employees of the railroad. On the Baltimore & Ohio the departmental headquarters handle direct certain administrative functions which, for the present at least, are cared for on the Missouri Pacific by the Bureau from its readily accessible Omaha offices, on the line of the system. On the Baltimore & Ohio the system instructor supervisor provided by the Bureau oversees and supplements the work of the traveling instructors, on behalf of both the railroad and the Bureau, while on the Missouri Pacific this service is performed by a member of the executive staff of the Bureau, working with the mechanical department of the railroad.

During the first year most of the work is the same for

* Hereinafter referred to as "The Bureau."

all classes of apprentices. Special craft instruction for each trade is scheduled to begin as soon as the fundamentals have been properly mastered. This elementary preparation includes, in one division of the work, mechanical and geometrical drawing, shop sketching and blueprint reading; in the other, general instruction, including the history of transportation, elementary mathematics, shop measurements, something about railroad shop expenses, cost of equipment, cost of delays, etc., and practical suggestions on accuracy in seeing, hearing and thinking. So far as is important or desirable the charts and other illustrative material used in sketching, drawing and blueprint reading are taken from the standard types of equipment in use on the particular railroad. Each apprentice is supplied by the railroad with a complete drawing outfit, which remains his property if he completes the full schedule of study. He pays for his own stationery and postage.

In the second year the boy gets into projection drawing and more specialized mechanical drawing on material for his own road; his general course carries him further in mathematics and gives him something in the mechanics of solids and of fluids, with practical problems in each. From this point on his work is almost wholly related to his particular trade.

The discipline provisions

In the first year's work the apprentice is required to send in, each month, one lesson in the drawing series and one in the arithmetic series. The plan provides automatically for elimination from the service when the apprentice is delinquent for three months, not necessarily successive, in maintaining the full schedule of two papers per month, unless reasonable explanation is shown, such as sickness or other cause beyond his control. He may be short one or both papers, for two months, without being removed, if he thereafter maintains an unbroken schedule, but unless some of this back work is made up, one more delinquency at any time without adequate cause will eliminate him. He is granted a hearing, at which if he so desires he may be represented by any other employee of his own choosing. On both roads he receives a warning after delinquency of two months. On the Baltimore & Ohio his hearing is held at the time of the warning; on the Missouri Pacific it is held when he has become delinquent for three months.

Helper apprentices of less than one year's apprenticeship, on the Baltimore & Ohio, who become three months in arrears are not removed but are set back to helper jobs, with their former seniority. Apprentices who complete their time and obtain regular journeymen's jobs before finishing their training studies are not required to complete the course but may obtain the remaining lessons if they desire, at their own expense, and it is stated that applications for such continuation are received daily. If papers are sent in which continuously fall below the required rating, after explanations by the examiners and personal help by the traveling instructors, no more lessons are sent until and unless the apprentice makes the required grade on his preceding work.

The apprentice who is dropped from the service is give one more chance. On the Missouri Pacific he may be reinstated if within ten days after his removal he brings to his supervisory officer two examinations properly filled out, provided that he promises to clear his record and live up to the schedule requirements of his technical training. On the Baltimore & Ohio there must be a similar pledge and all back work must be made up within the ten days. On neither road is he paid for the time lost between dismissal and reinstatement. If removed the second time he is not reinstated.

Much of this is something new in railroad apprentice training as we have known it thus far. There will be differences of opinion and reservations of judgment, of course, on what it will deliver in practical results as well as on the educational theory underlying it. Some of the departures from customary practice may prove more apparent than real as the plan is further rounded out, and it may be also that customary practice itself is fairly open to challenge on some of the assumptions commonly taken for granted. Certainly it will bring new attention and discussion to the opportunities still undeveloped in this promising field.

So far as concerns the maintenance of scheduled study the records in these first few months at any rate are rather remarkable. Approximately 1,000 apprentices are employed on each system. The "active students" average on each road in excess of 900; the difference consisting chiefly of apprentices completing their time within the month and new apprentices of less than two weeks' service. The plan was inaugurated on the Baltimore & Ohio on September 1, last, and in the first seven months the percentage of apprentices who were maintaining or ahead of the required schedule of two papers each month was, respectively, 64, 66, 73, 82, 92, 87 and 86. On the Missouri Pacific the plan went into effect November 15 and in the first five months the percentages maintaining or ahead of schedule were 73, 75, 83, 82 and 87.

On the Baltimore & Ohio, in January, there were 41 eliminations from service due to continued delinquency in maintaining schedules; 12 of these met the reinstatement requirements and were put back. The net removals were thus less than 4 per cent of the apprentice force. No surprise would have been felt, it is stated, if the eliminations had reached 20 per cent on this first "comb-over" of all the apprentices, the majority of whom had had no previous trade training and many of them only limited schooling. For the second period, the eliminations in February were 5, of whom 2 were reinstated; in March, 8, reinstated 2; in April, 5, reinstated 3. On the Missouri Pacific, where the plan is younger and where some delay occurred in enforcing the discipline, due to a peculiar problem in one district, there were about 25 eliminations to and including April.

A slight increase in delinquencies may develop in the next few months, for the reason that the work in mathematics is entering its most difficult phase, which promises to keep the traveling instructors more than ordinarily busy. Shop superintendents and master mechanics have been requested to give special attention to the boys during this period, for, as the letter from the Bureau points out:

> "The first stage has passed. Those boys who showed no aptitude whatsoever for study work have been eliminated, but there will come a second stage where the fellow who is bright but careless, where the fellow who is superficial and does not get down to facts and fundamentals, will find himself in deep water. The only way in which such a boy can make good on advanced study work is to get down to business and make up his mind that there is no easy way to acquire knowledge; that in order to gain more than a superficial knowledge of his work, he must do more than superficial reading."

It is further pointed out that while the apprentice instructors are endeavoring to bring home this idea to the boys, the master mechanic or shop superintendent has the greatest influence with them. "They listen to what he says. They know that he speaks with authority vested in him by his position." And, while the boys are credited with having made a remarkable study record thus far, these officials are asked to drive home to them that there is real work ahead, that every lesson slighted or hurried over will mean that much greater difficulty later on.

Some of the pros and cons

In other words, the same essential problems will be met here as in all systematic education. Since the boy's job depends upon his continued effort, the plan does provide more powerful motives than either the prospect of "graduation" or the fear of flunking, in ordinary school work. Will it supply also the necessary aids to proper understanding of the work required, especially in the case of boys of slow mentality or deficient in early school opportunities? Some interesting developments are under way bearing upon this problem, to which later reference will be made. It is chiefly a question of the extent to which a real individual relationship can be established with the boy and the factor of helpful personal contact brought into play.

This factor is not likely to occupy so prominent a place in any correspondence method, even when supplemented by visiting instructors, as it does in the class-room. On the other hand, advocates of the new plan claim for it certain distinct advantages of its own. The argument is that a larger measure of individual responsibility is placed upon the boy; that he must do sufficient study to complete a given schedule, rather than put in a fixed allotment of class hours per week; that the written lesson is a training in exactness and ability to express ideas; that there is less reluctance to ask questions on paper than in the presence of the brighter or better educated boys in a class room; that the time of the boys in class is sometimes consumed in discussion on the first questions raised or in help to the boys who first ask for it, most of them being at different stages in their studies and, except at large points, pursuing a variety of trade subjects in their later work; that there is such a thing as making it too easy for the boy to obtain immediate personal help whenever a difficulty is encountered; that, in fact, the modern educational tendency is towards independent effort and self-help on the part of the student.

Attention is called in this connection to the recent action of Harvard University in decreasing the time requirements in class and lecture attendance in order to permit of more opportunity for individual reading and study, a step towards the practice of English universities in this regard. No close parallel can be drawn here, of course, since the problem of mental preparation and general environment for study purposes is one thing with the college student and quite another with the average shop apprentice, but it is true that the general tendency is in evidence.

In the case of railroad apprentice training the further claim is made for the new plan that under it *all* apprentices on a given road, wherever employed, can be given the benefit of the training, while under the shop class plan the work is usually carried on only at points where enough boys are employed to justify regular class sessions and facilities. In cases where boys at outlying points are alternated at intervals with those at the larger shops, to give them a share in the class instruction, it is pointed out that the boys so exchanged necessarily lose some part of the training opportunity, apart from the question of added expense.

From the management standpoint, stress is laid on the fact that practically all the work is done by the boys on their own time, outside of working hours, except for individual appointments for help by the traveling instructor at times convenient to the supervision. It is pointed out that not alone is the direct financial economy a substantial one but that this plan avoids withdrawal of groups of boys during shop hours, thereby eliminating interference with the schedule of the mechanics they assist. This has been avoided under the shop class plan in certain instances by holding the sessions after hours, the boys being paid for all or a part of this extra time spent in class. Objection is put forward to this alternative on the ground not only of the additional cost in itself but of the twist given to the boy's view of the whole matter. The contention is that he should regard this study, not as a part of his regular current job to be paid for, but as an opportunity, as much in his own interest as in that of the company's, particularly at a time when technical training is becoming more and more a necessity to the boy who hopes to advance.

It goes without saying that none of these contentions will be accepted off-hand and without challenge. They are set down as the grounds upon which advocates of the new plan justify it in theory and expect it to justify itself in practice. As with all innovations its advantages are urged with energy and enthusiasm, but it is only fair to say that the plan is not put forward as the final and faultless word on the apprentice problem in railroading.

The question of personal contact

At just what points or in what ways do the elements of personal contact and group interest enter into the working program as developed thus far? From some viewpoints this is an aspect of apprentice training hardly second to that of the actual instruction given.

A certain degree of personal flavor can be injected, of course, even into correspondence with apprentices regarding their work. It need not be purely a matter of formal printed lessons, handled mechanically by routine examiners of whom the students know nothing. At Omaha the lesson papers arriving each day are distributed in such a way that a given examiner, for the most part, sees the work from the same group of boys. Those with whom I talked say that they can and do become familiar with the characteristic aptitudes, difficulties and mental slants of many of the apprentices and establish a direct relation with them by name, in connection with the explanations of errors and the asking and answering of questions. Many of the file letters written by examiners to individual boys who have not made a passing grade do exhibit the personal note of encouragement and advice and go into detail on the particular sources of trouble. There are indications to be seen in current work going through as well as in reports from traveling instructors that some at least of the boys show a considerable appreciation of the help given in this way.

Supplementing this, exceptionally good work on the part of an apprentice is called to the attention of his supervising officer, sometimes to that of a higher executive as well. In one interesting instance on the Baltimore & Ohio an electrician apprentice who had sent in some notably excellent sketches was given a trip to Baltimore, shown the electrical equipment and applications at the terminal, and personally encouraged in his work by the superintendent of motive power.

Individuality crops out to some extent, as might be expected, in the "get-acquainted" letters received in reply to the introductory letter to each boy, already referred to. "Do not hesitate to write us a long letter if you wish," is the invitation given: "The more we know about you the easier it will be for us to help you."

Cullings from the mail

I had the opportunity to inspect the entire mail, of several hundred letters, on two mornings in Omaha, including lesson papers, get-acquainted letters from new boys, questions, irregularities, and reports from traveling instructors. An interesting compilation might be put together of extracts from these human documents.

They are by no means remarkable in themselves, but do afford impressions of the personality and mental preparedness of boys about to embark on a given educational program. Here are a few sentences, taken at random from the mail of these two mornings, from both roads:

"I was not overloaded with education," wrote a helper blacksmith apprentice, who had quit school in the 7th grade to go to work. "To tell the truth I never was very fond of arithmetic or English in school. I did like physiology, history, spelling and geography. And I'm willing to learn anything else I can. I'm sending my first lessons with this letter, so if you can read this letter maybe you can read my lesson answers. And if I find a problem that I cannot get or figure out I'm going to ask help from you instead of letting someone else get it for me."

"I am a machinist helper apprentice, have been in the service a little over two years," said a young man in one of the large shops. "I like the work fine and like machine work better than the work on the erecting side. I have been out of school about eleven years." Another boy wrote: "The work in school that interested me most was along the manual training and machine shop line. I graduated from school in 1924. This year making three I have been out of school. Those three years make me see what I was doing. I was just drifting around, working every place but mostly not working at all. Those three years convinced me more than anything else that I needed a trade . . . My ambition is not to stay at the bottom of the machinist ladder, but to go as high as I possibly can." This from a blacksmith apprentice: "I want to keep on the addition, subtraction, multiplication and division, for I feel that I am not qualified to study fractions. Yet when you think I can start fractions you may send them on to me. I just went to the sixth grade in the public school. You know that I have not got much education. I am hoping that I can go through with your schooling O. K."

To the question in one of the introductory lessons why an apprentice should set a goal of accomplishment for himself a helper painter apprentice answers: "I think about as good a reason as any is that he will go about his work with a lighter heart, find more pleasure, and do better work. And another thing is that a fellow cannot succeed or accomplish anything if he hasn't anything to work to. If a man does not care for his work he will be sure to fail."

The characteristics of a good leader, as observed in men of their own craft, says a boilermaker apprentice, are: "Interest in his work, always trying to do more and learn more than is required of him, to study and observe and listen to the things that are did and told to him by men higher than himself. Honesty and respect to all fellow men."

A car builder apprentice thinks that the advantage in showing interest in work and courtesy to associates is that "the other fellowmen will take an interest in you. If a man tells you anything, one should listen closely to what is said and if you do not wait until he is finished you can hardly expect a courteous reply from him the second time." The same boy believes that the advantage of a technical training plus practical experience, over experience alone, is that the apprentice "will learn more faster how to do the work better and more easier and yet he will be promoted more quickly."

Whatever else such communications may indicate, no one is likely to suggest "internal evidence" of copying from a lesson book! It should be noted that in this first year the examiners are not making corrections in spelling and grammatical forms, the grading having to do wholly with the boy's understandings of the lesson problems.

A machinist apprentice, who connects his lessons with his shop experience and associates, illustrates thus his idea of sketching and sketch-reading: "At some time an engine might break down on the road and some complicated part broken some one would have to make a sketch of this part and if not properly sketched it would cause a lot of delay waiting for it. . . . Say I was running a lathe and Carl brought me a sketch of an appliance he wanted to have made and try out. I would have to be able to make it from the sketch."

In the mail was a letter from a sheet metal worker apprentice, one of four who had recently made a visit to what they call "the school," in Omaha, and who apparently had written for help on some of his work. The explanation, he says, "was very satisfactory in every way and I hope I will not have to bother you any more. . . . I feel free in writing you about anything concerned, realizing that it is quite a task that you have on hand to handle all the school transactions."

Whatever significance such pickings from a typical mail may have, unimportant in themselves, lies in the extent to which, be it much or little, they disclose elements of personality to the examiners who must work back and forth through this means chiefly, and to the instructors and supervisors who are expected to make direct contacts with the boys on the job.

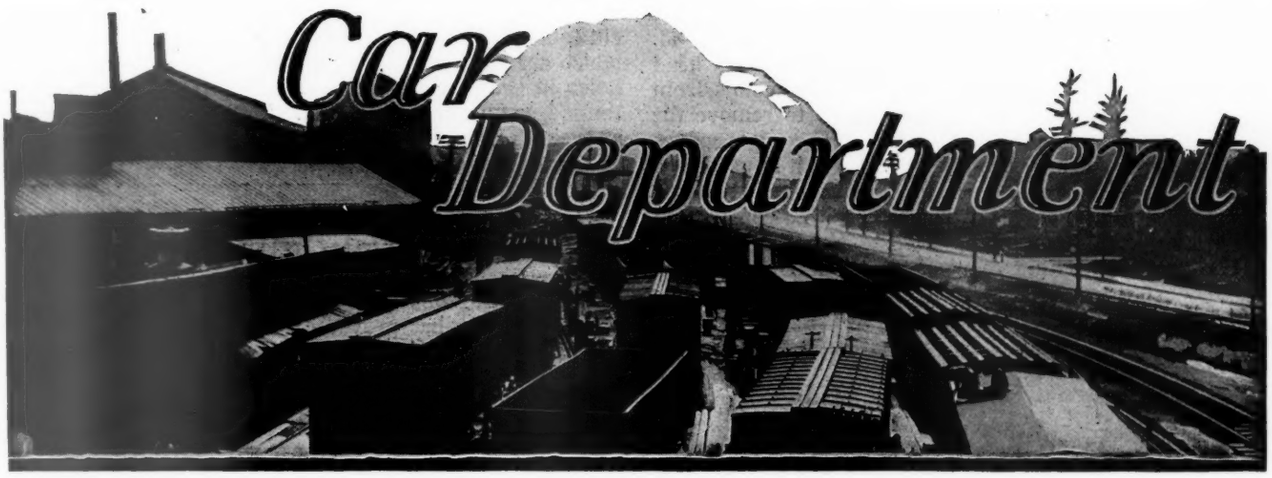
The instruction staff

The personality, experience and special aptitude of the traveling instructor will necessarily have much to do with the problem of getting at the individual boy, of measuring his capacities, affording him sufficient but not too much help with his difficulties and the kind of friendly encouragement he needs. All the instructors on the two roads are men of practical shop experience, two of them in mechanical engineering, the others as mechanics in various crafts and with further service either as draftsmen, inspectors or foremen. All have served previously as teachers of apprentice classes, either on other roads or under former training systems on the road of present employment.

One was for several years director of vocational work in the public schools of a large city and later of the manual arts department in a high school. Both of the system instructor supervisors, five of the traveling instructors, and one shop instructor on schedule work who also assists boys in their studies as required, have themselves served a mechanical apprenticeship. Both the system supervisors have served as foremen and one of them as president of the system machinists' organization.

I made the acquaintance of four of these gentlemen and visited shop points with two of them; a fifth I had previously known. All are unlike in personal characteristics, but each gives the impression of a practical and human rather than a schoolmaster view of his work. Of their interest in it there can be no doubt. The examiners, at Omaha, are men of more varied industrial experience in which is represented engineering, accounting, efficiency work, drafting and design, and various supervisory functions. Six of the nine have seen railroad service; several have pursued night school or correspondence courses in technical subjects, as a part of their educational experience.

[The second and concluding part of this article will be published in the September number of the *Railway Mechanical Engineer*.—EDITOR.]

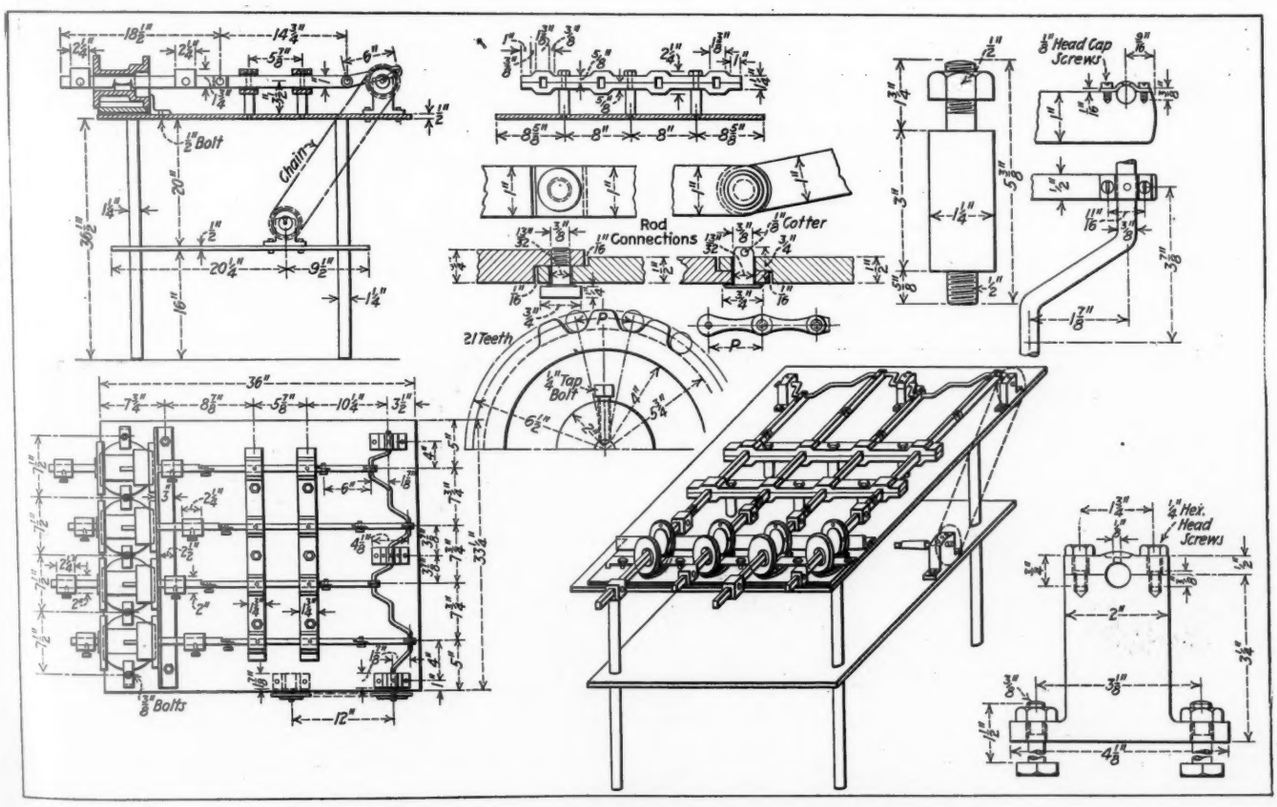


Machine for lapping slide valve seats in triple valves

IN shops where large numbers of triple valves are repaired, considerable time can be saved by employing mechanical devices and machines for doing work formerly done by hand. Lapping the seats for slide valves in triple valves is an operation that can be handled to advantage on the machine shown in the illustration. The machine is simple in construction, can be operated by a small air or electric motor, or driven from a line shaft. The machine is arranged to handle four triple valves at one time, and can be designed for any number of valves by making as many units as required to handle the number of valves to keep up with the work.

The frame and base plate of this machine is built up of boiler plate and 7/8-in. iron rods using 1¼-in. iron pipe to space the plates. The crank shaft is forged steel with a 1⅞-in. throw and has three main bearings made of cast iron. The connecting rods are made of ½-in. by 1-in. iron which are held in position by small bearing caps secured by ⅜-in. cap screws. The machine is equipped with a double set of guides in which the connecting rod slides work. This prevents any tendency for the valves to rock on the seats. Hardened steel blocks, hard wood blocks, or soft metal blocks made to the shape and size of the valves are used to lap in the seats. The valves are usually lapped in on a rotary face plate, or by other means.

All rod and slide connections are made with knurled head screws. It is not necessary to disconnect any part



Machine for lapping the slide valve seats in triple valves

of the machine when removing or placing the triple valves. The lapping blocks are balanced by 1½-lb. weights which are held in position by knurled head screws. It is only necessary to remove the clamps from the valves and the outer weight in order to remove the valves and put others on the machine. The triple valves are lined up square by the angle iron which is used as a face plate. The drawing shows the machine arranged for chain drive, however the machine can be constructed for belt drive or direct motor drive.

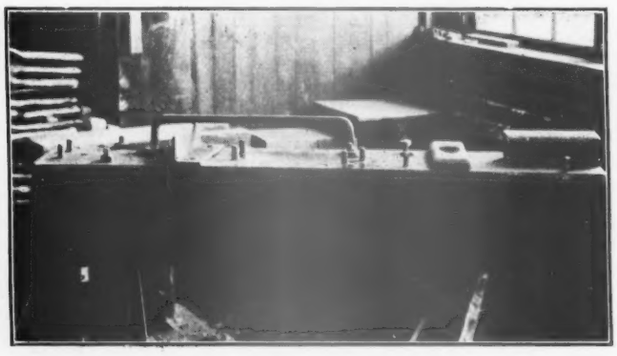
The amount of time required to lap the triple valve

The valve lapping can be arranged for either belt, motor or chain drive

seats will vary according to the condition of the seats and the methods used for lapping. Where large numbers of the triple valves are handled this machine will pay for itself in a very short time. The design is simple and the machine can be constructed in any shop with material on hand, no special castings or forgings being necessary, with the exception of the crank shaft.

Reclaiming grab irons in the blacksmith shop

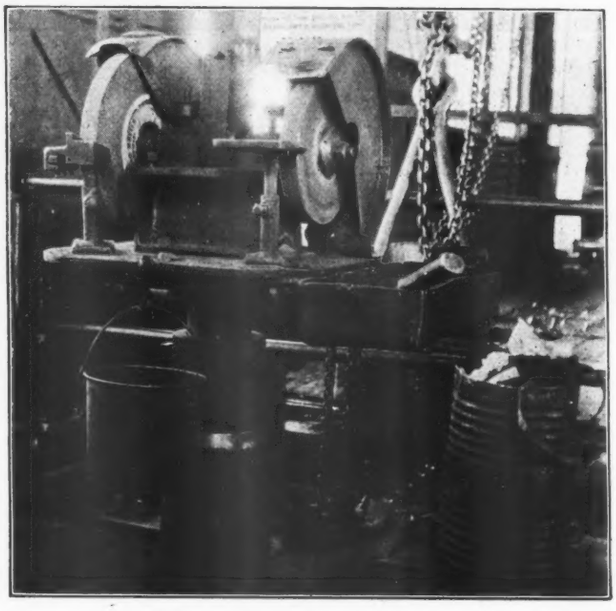
THE illustration shows a fixture for bending and gaging grab irons. The grab iron is heated and the feet are bent over the block on the end of the fixture which is the correct height to give the required clearance between the inside of the grab iron and the side of the car. The feet are shaped in the die shown at the left of the block. A number of plugs are located on either side of the angle riveted to the top of the fixture, which are used for gaging the distance between the rivet holes in the feet of the grab irons. The plugs are arranged so that a combination of any two will serve to gage grab irons for one series of cars. The vertical leg of the angle gages the height.



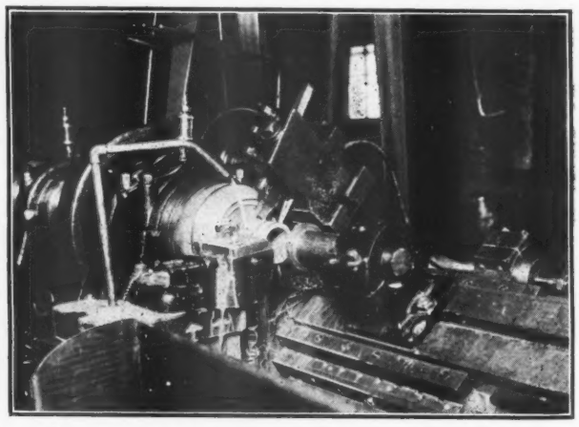
Fixture for reclaiming grab irons in the blacksmith shop

Adjustable grinding wheel stand

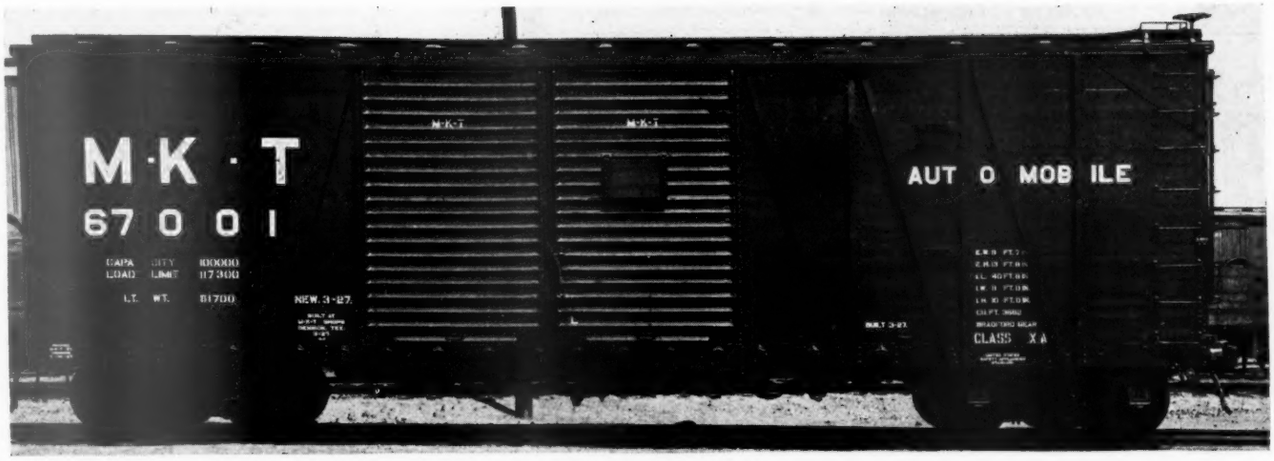
THE adjustable grinding wheel stand shown in the illustration has proved a valuable innovation in the wheel shop at a large car repair plant. The wheels, guards and two adjustable gages, or tool rests, are all mounted on a base of ¾-in. steel 18 in. square. To the edge of this base is welded a box of light sheet metal which holds small tools. The base is mounted on the regular stand made for this purpose, with the addition of two set screws which allow the machine to be raised or lowered or turned in any direction desired.



An adjustable grinding wheel stand



Turning out valve motion bushings on a single spindle automatic machine

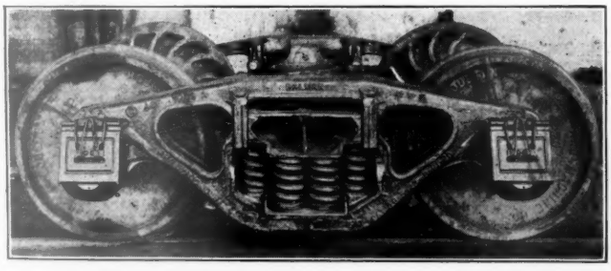


Fifty-ton automobile car built by the Missouri-Kansas-Texas

Fifty-ton automobile cars for the M.-K.-T.

Designed for use in general box car and grain traffic— Equipped with 12-ft. side doors

THE Missouri-Kansas-Texas is building 500, 50-ton single sheathed box cars at its steel car shops, Denison, Texas. These cars were designed, not only for handling automobiles, but also for general box car service and for carrying grain. The length over the striking castings of these cars is 42 ft.



Truck used under the M.-K.-T. automobile cars

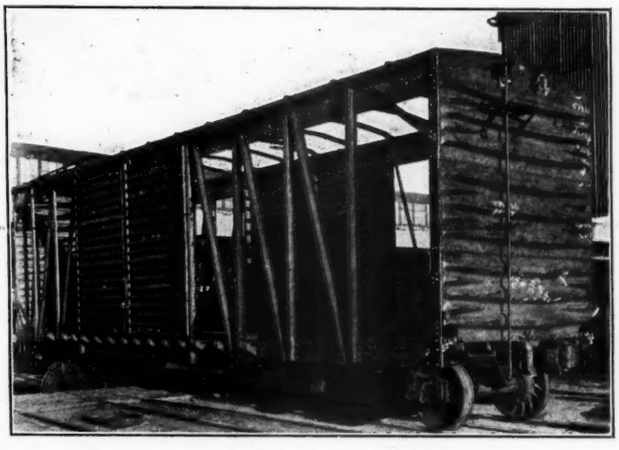
1½ in. and the body has an inside length of 40 ft. 6 in., inside width of 9 ft. and height of 10 ft. 7/16 in. A number of interesting features have been incorporated in the design of these cars, one of the most important being the large side door clear opening, which is 12 ft. wide by 9 ft. 4¾ in. high.

The superstructure

The superstructure is composed of two interchangeable trusses riveted to the side sills, each truss being framed in eight panels, including the door opening. The center line of the door opening is located 4 ft. ⅝ in. beyond the transverse center line of the car to facilitate the loading of automobiles, especially those having long wheel bases.

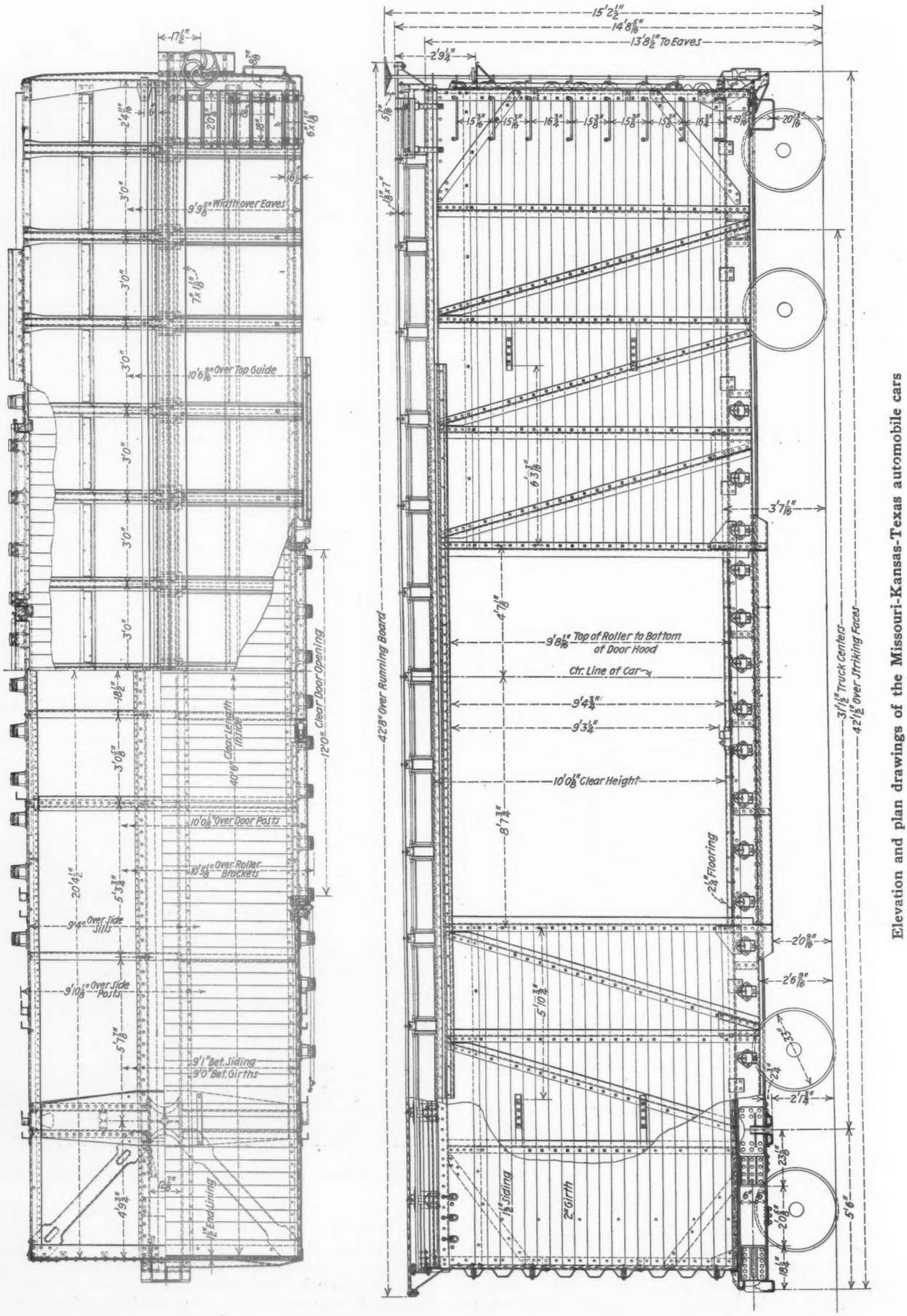
The door posts are 4 1/16 in. 10.3-lb. Z-bars and the side posts and diagonal braces are 3 1/16-in. 8.5-lb. Z-bars. The side plates are 4 1/16.-in. 10.5-lb. Z-bars reinforced with ¼-in. by 17-in. steel plates, which extend from the door posts to the ends of the car. All the side posts and diagonal braces are riveted to the side sills and side plate reinforcing plates. In addition, a reinforcing member consisting of a 4 1/16-in. 10.3-lb. Z-bar is riveted to the side plate over the doorway. This member also forms the riveting flange; as well, for the door hood.

The cars are equipped with bottom-hung Youngstown corrugated steel double doors, as shown in the illustrations. The doors are provided with bottom rollers and brackets, door stops and locks, furnished by the Union



View showing the frame and end construction

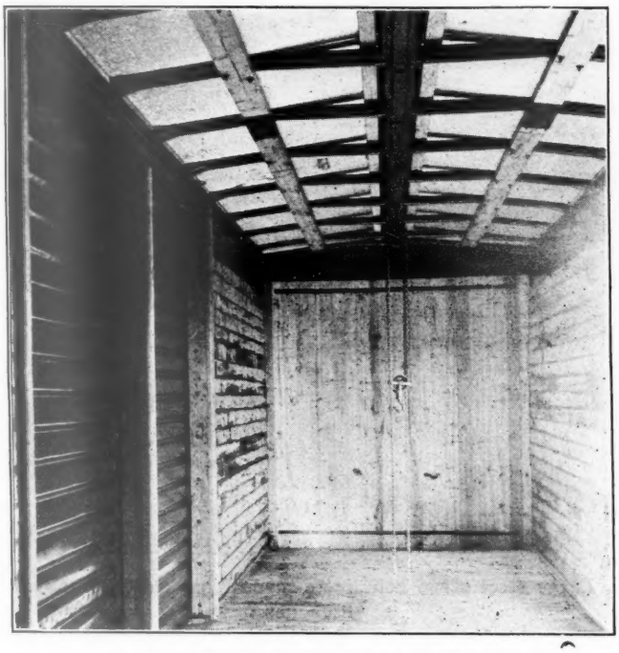
Metal Products Company. These cars are also equipped with Dreadnaught steel ends and with Hutchins Universal roofs, No. 16 gage, which are provided with steel running board saddles and pressed steel carlines. The Hutchins chain fall support section is applied to each car, extending from end to end along the longitudinal center



Elevation and plan drawings of the Missouri-Kansas-Texas automobile cars

line, and securely riveted to each car line. The inside of each car is equipped with 32 wrought iron lifting rings secured to the side plates.

The flooring is No. 1 common dense southern yellow pine, 2¼ in. thick, tongued and grooved, and the sheathing is No. 2 clear and better vertical grain Douglas fir, 1½ in. thick, with the part forming the girth 2 in. thick.



Interior of new M.-K.-T. automobile cars

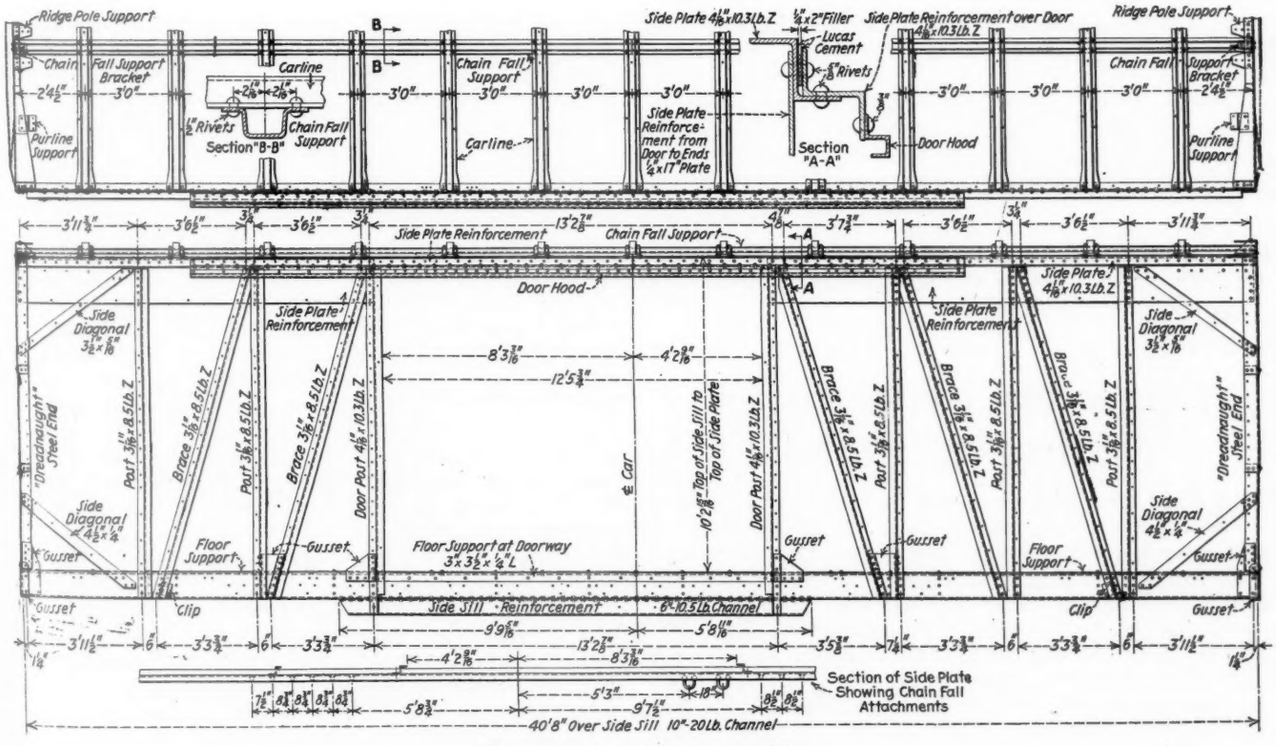
The side girth consists of ten boards and is located 33⅜ in. from the bottom of the floor and extends up 51¼ in. All siding extends in one piece from the door posts to the steel ends. The end lining is 1½ in. thick of No. 1 common dense southern yellow pine.

The underframe

The underframe of the car is of steel construction, the center sills consisting of 12-in. 40.3-lb. rolled steel A. R. A. standard center sill sections, which extend continuously between the end sill striking castings. The center sill cover plate is of copper-bearing steel. The side sills are 10-in. 20-lb. channels reinforced under the door opening with 6-in. 10.5-lb. channels. The bolster is of the box girder type, having two copper-bearing steel diaphragms, and top and bottom cover plates of copper bearing steel. There are live crossbearers of copper-bearing steel, having top and bottom copper-bearing steel cover plates. The car has four copper-bearing steel crossties, two of which are located between the crossbearers and two between the crossbearers and bolsters.

The general dimensions of the Missouri-Kansas-Texas automobile cars

Length inside	40 ft. 6 in.
Width inside at floor	9 ft. 1 in.
Width inside of girth	9 ft. 0 in
Height inside	10 ft. 7/8 in.
Length over striking castings	42 ft. 1½ in.
Length over end sills	40 ft. 9 in.
Width over side sills	9 ft. 4 in.
Width side door opening, clear	12 ft. 0 in.
Height side door opening, clear	9 ft. 4¾ in.
Width over eaves	9 ft. 9⅝ in.
Height top of rail to top of floor	3 ft. 7 7/8 in.
Height top of rail to running board	14 ft. 8 1/8 in.
Height over hand wheel	15 ft. 2½ in.
Distance center to center of trucks	31 ft. 1½ in.
Cubic contents	3,682 cu. ft.
Capacity	100,000 lb.
Light weight	51,700 lb.
Load limit	117,300 lb.



Superstructure frame assembly

The end sills consist of 6-in. by 4-in. by ⅜-in. angles.

The couplers are Type D with 6-in. by 8-in. shanks. The draft gear is the Bradford type R-1-A. The Union

coupler centering device and the Imperial top-operated uncoupling rigging are used.

These cars are equipped with Dalman 50-ton trucks having 5½-in. by 10-in. journals, with the journal boxes cast integral with the side frames. Wood's roller side bearings are used. The journal box lids are the Railway Steel Springs Company's torsion type. The journal boxes are fitted with Security dust guards.

The cars are equipped with Ajax No. 2+ brake beams,

Side and underframe construction used in the new M.-K.-T. automobile cars

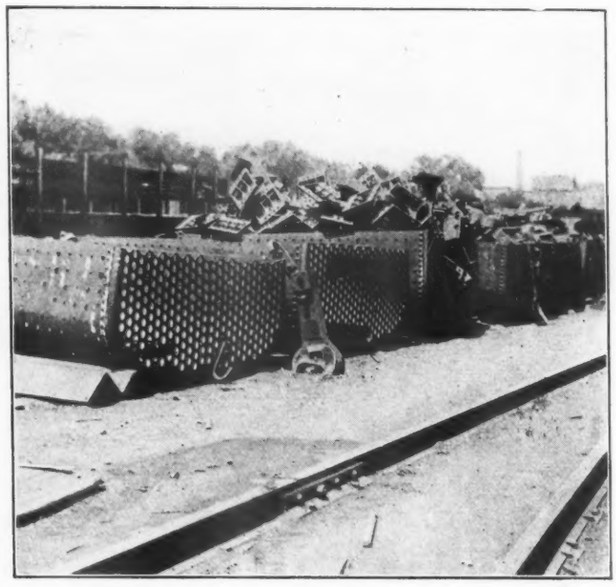
Creco third point support and Universal bottom rod supports. Shaefer bottom rods are used. The brake step is of pressed steel furnished by the Viloco Company. The Universal hand brake attachment is applied to all of the cars.

The air brake equipment is the New York Air Brake Company's type C, 10 in. by 12 in., with double pressure retaining valve. Double strength piping has been used to provide ample protection.

Large steel containers for salvaging scrap

MANY tons of broken and worn out parts of cars accumulate at railroad shops. The salvaging of this scrap is an economical operation. The scrap containers, shown in the ilustration, have proved a great aid in this work at a large car repair point. They are made by cutting off the fireboxes of oil boilers with the acetylene torch, and bolting on four heavy hooks, two at each end. One of these is near the bottom at the middle of the firebox; the other near the top corner. With this arrangement they are easily picked up when full, dumped into a scrap car, and replaced with a crane. Two chains are hooked on the top hooks, while two others fasten onto the bottom hooks and pass up under the opposite side of the container. When ready to dump, the chains are loosened from the top hooks and the other chains roll the container over and pick it up again, empty.

In this way, by placing the containers at several con-



Large steel scrap containers made from old locomotive fireboxes

venient points along the tracks, the different grades of scrap are easily kept separate. Each container is labeled and only scrap of the designated grade is placed in it.

Constituents of varnish

A HIGH grade railway coach finishing varnish generally contains Kauri gum which comes from Aukland, New Zealand, and is the fossilized rosin of a tree known as the Agathis Australis which grows to a height of over 150 ft. with no branches lower than 100 ft. The life of the tree is approximately 300 years.

The gum fields are at present barren, the trees having been covered with earth for at least 3,000 years until the sap has become fossilized which is the Kauri gum of today. Kauri gum was discovered on Nov. 16, 1769.

Congo gum from the Congo Free States in Africa, and pontianak from the Dutch East Indies are also used in small quantities. Ester gum, which is rosin gathereed from the pine trees of Louisiana and the Carolinas, esterfied with glycerine which in turn is made by the saponification of animal fat, is used. Glycerine is a by-product of the soap industry.

Linseed oil, which is pressed from the flax seed of Argentine or the northwestern part of the United States, and china wood oil which is pressed from the nut of the tung oil tree grown in Southern China and brought down the Yangtze river in small boats to Shanghai, are the two principal oils used.

Salts of metals are used as driers. Litharge and red lead are driers which are made by melting metallic pig lead to a dressing oven in which a current of air passes over the surface of the molten lead and converts it into litharge. Lead is mined in western United States.

Manganese mined in Caucasia, cobalt mined in South America and zinc from the Franklinite deposits in New Jersey may also be used as driers.

Turpentine gathered from pine trees of Louisiana and the Carolinas and naphtha which is a distillate of petroleum are used as thinners.

The finished job, ready for service

Nickel plate repairs automobile cars at Conneaut

Adoption of progressive system results in output of two cars a day with small force

IN maintaining its freight cars the New York, Chicago & St. Louis concentrates heavy repair operations at five different points, namely, Conneaut, Ohio; Lima, Ohio; Tipton, Ind.; Frankfort, Ind., and Stony Island (Chicago), each of which points specializes on certain classes of cars.

This article describes the general repairs to a group of 1,256 automobile cars—all of which were built during the year 1917. The repair work on these particular cars has been concentrated at Conneaut, Ohio, because this shop is convenient to a large number of automobile loading points.

The operations are being carried out on the progressive repair system wherein the cars are spotted on the repair tracks and specialized repair gangs move from car to car. This system was adopted because of the layout of the repair facilities at Conneaut which does not particularly lend itself to the station-to-station system of repairs. The entire repair operation is carried out in 10 principal detail operations, seven of which are performed on the cars while in an enclosed repair shop.

The shop in which these cars are being repaired is a six-track, fully enclosed structure 430 ft. in length, one end of which is served by a transfer table which also serves a locomotive shop opposite and a boiler shop adjacent to the car shop. Four of the six tracks in this car shop are working tracks, the remaining two being used as material handling tracks. Repair operations on the automobile cars involve only two of the working tracks, the remaining two working tracks at the present time being used in the general classified repairs to a series of gondola cars. The shop is equipped with permanent scaffolding suspended from the roof trusses, but is not equipped with overhead traveling cranes for lifting heavy parts.

Description of cars

The cars under consideration are 40-ft. automobile cars of 80,000 lb. capacity with steel underframes and wood superstructures having two-piece corrugated steel ends and outside metal roofs. Two hundred of the cars have two-part steel end doors with corrugations running vertically. The posts, braces, plates and sub-side sills are all wood; the center sills of plate and angle fish belly construction and the side sills of Z-bars. The body bolsters and diaphragms are of built up steel construction. The car doors, of which there are two on each side with movable center posts, are metal bound wood doors, bottom supported. The cars are equipped with cast steel truck side frames with which the journal boxes are cast integral. The journals are 5 in. by 9 in. and the wheels are 33 in. cast iron. As originally built, the cars

were equipped with the tandem type spring draft gears.

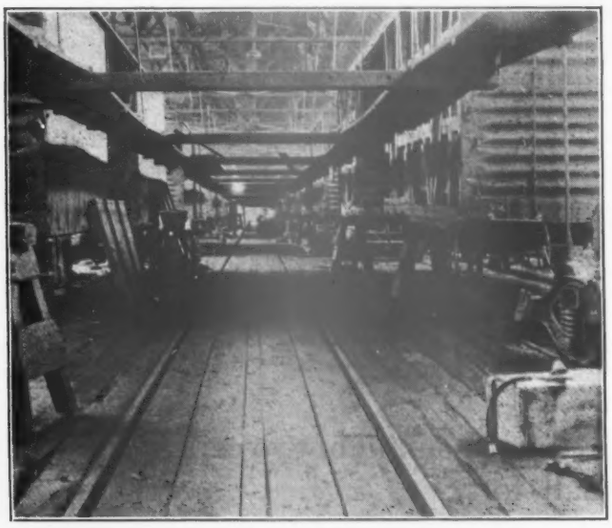
Detail operations

The entire repair job is being handled in the following 10 detail operations in the order named, with the exception of No. 8 which is worked in at any time after the completion of Operation No. 3:

(1) Stripping; (2) Trucks and car framing; (3) Steel work; (4) Floor and lining work; (5) Sheathing; (6) Roof; (7) Doors and safety appliances; (8) Air brake work; (9) Painting; (10) Stenciling and final inspection.

Operations 1, 9 and 10 are performed outside of the shop; the remaining seven operations are performed within the shop.

Operation No. 1—*Stripping*—Remove roof, sheathing, lining, floor, door fixtures and safety appliances. Remove all blocks, cleats, nails, etc. All serviceable parts removed are placed inside of the car and follow the car to the erecting tracks. All unserviceable parts are placed in scrap cars. Scrap cars for wood and metal



Looking down the shop between the two repair tracks—seven cars on each track

parts are located at convenient points so as to eliminate distant movements when handling the scrap.

Operation No. 2—*Trucks and car framing*—General repairs to trucks. The trucks are torn down and all defective parts renewed. In the car framing new posts and braces are applied on this operation. Side plates and side plate splices are renewed where necessary. The diagonal steel end tie rods are tightened.

Operation No. 3—*Steel work*—The draft gear is overhauled; reinforcing angles are applied to the side sills at the bolsters; steel car ends are straightened; general repairs are made to all steel work; all frame tie rods are tightened up; the coupler is adjusted to the proper height.

Operation No. 4—*Floor and lining work*—Floor, lining and grain strips are applied.

Operation No. 5—*Sheathing*—Sheathing is applied to car.

Operation No. 6—*Roof*—The old roof boards (undercourse) are renailed and the new roof is applied. Door tracks and fillers are applied.

Operation No. 7—*Doors and safety appliances*—Doors and removable door posts, and safety appliances are applied to the car. Bolts through steel end gusset plates are applied.

Operation No. 8—*Air brake work*—Piping is renewed where necessary; angle cocks are extended to conform to A.R.A. requirements; triple valve changed; brake cylinder and retaining valve cleaned, oiled, tested and stenciled.

Operation No. 9—*Painting*—Before painting the car

The trucks are overhauled in the space between the cars

the roof, underframe and steel ends are scraped and then sprayed with one coat of medium car cement. One coat of primer is applied to the new sheathing before application to the car. The final painting of the sheathing consists of two coats of freight car brown paint, sprayed on. The inside of the metal roof receives one coat of freight car brown before application. The insides of the doors, the side plates and the roof boards from the side plate to the first purlin receives one coat of freight car brown paint.

Operation No. 10—Stenciling and final inspection—

A line of seven cars nearing completion—Material is placed at each position

The cars are stenciled. Shellacked paper stencils are used, mounted in wood frames with piano wire bindings.

The side doors and roof platforms for these cars are made in the wood mill, this operation not being included in the list of detail operations given, nor shown in the statement of forces employed on this job.

Forces employed

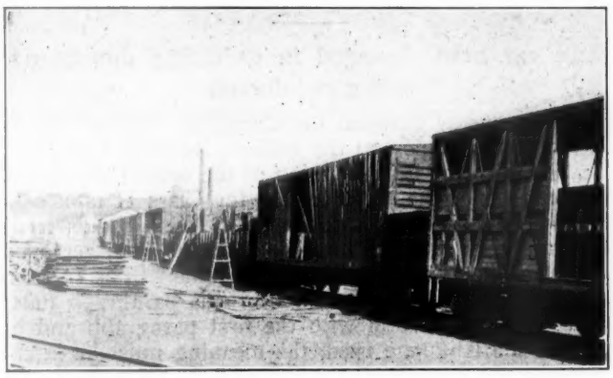
All men in this car repair operation are employed on a piece work basis. The distribution of the men is as follows:

Operation No. 1—*Stripping*—Two gangs each consisting of two helpers, making a total of four men.

Operation No. 2—*Trucks and car framing*—One gang consisting of two car repairers; total, two men.

Operation No. 3—*Steel work*—Two gangs each consisting of two car repairers; total, four men.

Operation No. 4—*Floor and lining*—One gang consisting of one car repairer and one apprentice; total, two men.



The cars are stripped on a track outside the shop

Operation No. 5—*Sheathing*—One gang consisting of two car repairers; total, two men.

Operation No. 6—*Roof*—Two gangs each consisting of two car repairers; total, four men.

Operation No. 7—*Doors and safety appliances*—One gang consisting of one car repairer and one apprentice; total, two men.

Operation No. 8—*Air brake work*—One gang consisting of one mechanic and one helper; total force, two men.

The air brake gang is employed in handling the air brake work on all four working tracks in the shop and as a consequence, in this instance, only part of their time can be charged to the repairs to these automobile cars. In addition to the above, one welder is employed, on a day work basis.

Operations No. 9 *and No.* 10—*Painting and stenciling*—This work is performed by painters assigned by the paint foreman who has charge of the paint work on all cars repaired at Conneaut Shops. No definite assignment of men is made to this particular operation.

With the exception of the acetylene welder, air brake men and painters, the total forces employed consist of 10 gangs comprising a total of 12 mechanics, 4 helpers and 2 apprentices.

Material handling

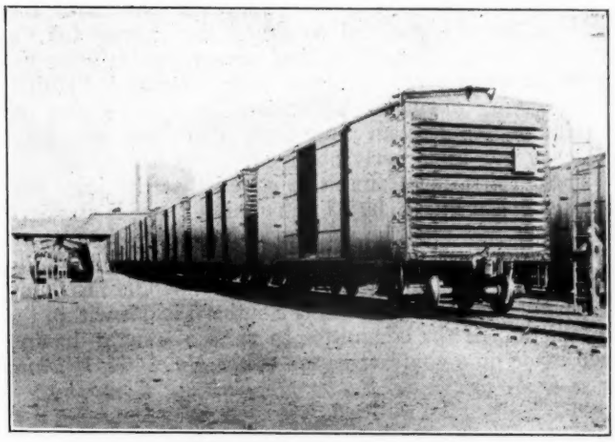
Three men are employed to supply wood parts to the repair tracks and two men to supply metal parts. These five men furnish all the material for the entire heavy car repair shop. These men bring all material from the storehouse platform and wood mill to the repair tracks as it is required. On the two repair tracks two men, one for wood and one for metal parts, are assigned to supply material to the individual cars on the two tracks. When the cars are placed on the erecting tracks after being stripped, a metal parts supply man checks over each car and makes a note of the metal parts to be renewed. Parts that require repairs are taken from the car and placed in a pile on the floor of the shop near the door opening of each car. When the entire track has been checked for new parts and parts requiring repairs, the metal parts supply man gives the foreman in charge a list from which the necessary order on the stores department or blacksmith shop is prepared. The supply men then take the material to the blacksmith shop for repairs and return it to the cars after the work is done. They also place new parts at the cars. The metal parts supply men deliver all metal roofs to the cars in time to permit the painters to apply one coat of paint before the roof is applied to the car.

The wood supply men check the cars for wood parts in much the same manner as described above. Framed material is placed at the cars in sufficient quantities as needed. Sheathing is placed at the corners of the cars. Lining is placed inside the cars. Flooring is laid in the car door openings with the rings of the wood down. Posts, braces and other framing parts are placed against the side of the car, as are also the roof platforms. After the sheathing is applied the supply gang delivers the side doors and assists in lifting them into position on the door tracks.

Material is handled on manually operated material wagons. Any surplus material is gathered up from the cars after the repairs are completed and either returned to the storage platforms or placed at other cars

Method of performing the work

A total of 14 cars are spotted, there being seven positions on each track in the shop. Operations are scheduled in a manner which results in the completion of two cars per day. On this basis the seven cars on each track are completed, ready for pulling out, on an average of every three and one-half days. All detail operations are scheduled on a two car a day basis and the forces are assigned in a manner to carry out this schedule. For example, on Operation No. 1 it was found that one gang could strip a car in eight hours. On Operation No. 2 the time was four hours per car per gang; on Operation No. 3, eight hours; Operation No. 4, four hours; Operation No. 5, four hours; Operation No. 6, eight hours and Operation No. 7, four hours. On this basis, then, the assignment of two gangs each to Operations Nos. 1, 3 and 6 and the assignment of one gang to each of the remaining operations made it possible for each operation to be worked out on a two car a day basis.



After leaving the shop the cars are spray painted

Cleaning passenger equipment —A correction

AN error was made in giving the name of the author of the article entitled "Cleaning passenger equipment," which was published in the June, 1927, issue of the *Railway Mechanical Engineer,* page 335. This article was contributed by Monsieur Hubert, principal engineer of equipment, Paris, Lyon & Mediterranean, Paris, France.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Joint evidence for wrong repairs made at contract shop

S.T.C.X. tank car No. 8368 was derailed and turned over by the Wichita Falls & Southern with the result that the side and end running board were torn off. The handling line sent the car to the Panhandle Refining Company's shop to be repaired on contract. In renewing the running board it applied boards measuring 1⅞ in. thick by 11½ in. wide all around the car. After the repairs were completed, the car was sent to the Texhoma Refining Company for loading. A representative of the owner took exception to the running board and obtained a joint evidence card. The repairing line issued its defect card to cover the wrong running board applied in accordance with Rule 12. The Panhandle Refining Company declined to cancel the charge for the running board, contending that wrong repairs were not made inasmuch as the cars were stenciled "United States Safety Appliances Standard" and 1¾ in. is the maximum requirement and that, therefore, the joint evidence was improperly obtained.

The Arbitration Committee stated that the joint evidence shows a 2¼ in. by 12 in. running board is standard to the car and that the standard of the car owner must be maintained. It stated that the quesion of responsibility for wrong repairs between the Panhandle Refining Company and Wichita Falls & Southern is not within the jurisdiction of the committee in view of repairs having been made on a contract basis.—*Case No.* 1464, *Wichita Falls & Southern vs. Panhandle Refining Company.*

Car damaged by oil on the outside obliterating stenciling

The Swift Refrigerator Transportation Line received its car No. 18217 from the Texas & Pacific on March 21, 1925, with the entire right side of the car covered with oil. The owner submitted a joint statement to the T. & P. requesting that it be furnished with a defect card authorizing a bill for labor and material expense for repainting. The owner contended that although A.R.A. rules do not specifically cover a case of this kind, Rule 32, Caption K, applies as the principle involved would be the same, and that, furthermore, Interpretation No. 3 under this rule would uphold the owner's claim, as the Arbitration Committee ruled that paint missing due to hot lading placed in a car is a cardable defect, providing the damage is such as to require shopping the car. The T. & P. could not account for the oil on the car and was of the opinion that the condition of the car was the owner's responsibility under Rule 43.

The Arbitration Committee ruled that the car was not subjected to any of the unfair conditions of Rule 32 and that the car owner is responsible.—*Case No.* 1465—*Swift Refrigerator Transportation Company vs. Texas & Pacific.*

Tank car head damaged in switching due to not being re-inforced

A controversy between the Terminal Railroad Association of St. Louis and the Indiana Refining Company, Inc., involved the interpretation of the second paragraph of Section 5 of the specifications for Class II tank cars reading as follows: "Paragraph 2. This requirement shall apply, also where head blocks have been removed and the tank anchored to the underframe." The Indiana Refining Company contended that this paragraph must be read in conjunction with the first paragraph and in view of the language used, the meaning must be interpreted that where tank heads are 7/16 in. or over in thickness, it is not required to re-inforce the tank heads with steel shoes of ⅜ in. in thickness when the head blocks have been removed and the tank anchored to the underframe, even though the tank heads may bear evidence of being indented by the head blocks. In other words, the Refining Company contended that the first and second paragraphs of Section 5 pertain only to tank heads of less than 7/16 in. in thickness and that the specifications do not have any requirements covering cars equipped with tank heads of 7/16 in. in thickness or over. The Terminal Railroad Association of St. Louis stated that on March 16, 1925, while in switching service, the head in one end of I.R.C.X. tank car No. 1710 cracked for about one-half of its circumference in the bend of the head. The car had been originally equipped with a head block anchorage and at some prior date center anchorage had been applied, but the owner had failed to comply with the second paragraph of Section 5, Specifications for Class No. II Tank Cars, as steel reinforcement shoes had not been applied to the head even though the head which failed showed evidence of distress at the point where it had formerly come into contact with the head block, the depression being 1¼ in. deep by 14 in. long.

The Arbitration Committee ruled that under the present specifications for Class II tank cars shoes are required only where the tank heads are less than 7/16 in. thick, but noted that this decision is at variance with the intent of the tank car specifications which will be modified to make mandatory the application of reinforcing shoes in any case showing evidence of distress without regard to thickness of the tank head.—*Case No.* 1467—*Indiana Refining Company vs. Terminal Railroad Association of St. Louis.*

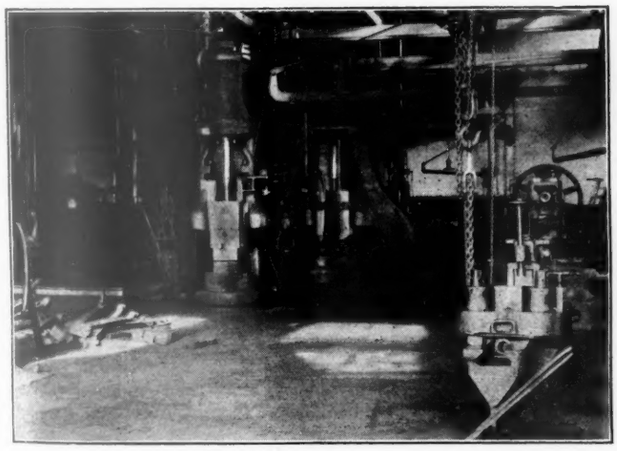
EQUIPMENT FOR POWER PLANTS.—"Equipment for Power Plants" is the title of Bulletin H. O. 1900 recently issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. This bulletin discusses modern power plant practice, particularly as regards steam condensers, pumps, air compressors, Diesel engines, gas engines and oil and water meters. The bulletin is well illustrated and contains practical information for power plant and consulting engineers.

Boston & Albany blacksmith shop at West Springfield

Considerable attention has been given to the heat treatment of locomotive parts and small tools

LOCATED at West Springfield, Mass., are the main locomotive repair shops and engine terminal of the Boston & Albany. The blacksmith shop, 160 ft. long by 88 ft. wide, fully equipped to handle all blacksmith work originating at the back shops and enginehouse, is an important unit of the shop group located at this point. The shop force consists of 45 men headed by a foreman and an assistant foreman.

The shop is well ventilated and lighted by skylights and windows that are kept clean. It is divided into two

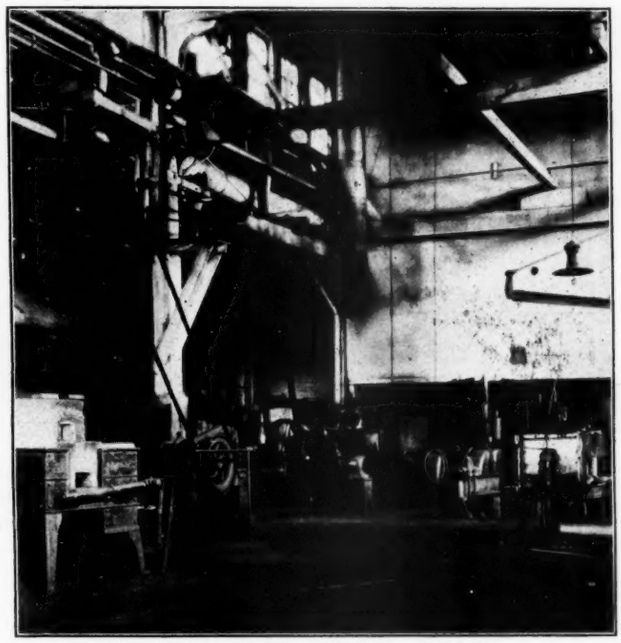


Looking towards the 5,000-lb. steam hammer and stock adjusting machine

sections, the larger of which houses the large hammers, furnaces, blacksmith fires, spring repair machinery, etc., while in the smaller section is located the forging machines, a Beaudry and a Bradley power hammer and two motor-driven Sturtevant blowers. The No. 9 blower supplies 14 oz. of air to all the oil furnaces and the No. 7 blower supplies air to 17 blacksmith forge fires. These two blowers are operated at 1,800 r.p.m.

All dies are made in the shop

As is customary in most blacksmith shops, all the dies are made in the shops and they are kept in a separate



A view of the bolt header and forging machine room

building alongside of the shop. Of the many dies in use in the shop, the foreman is particularly proud of five for the development of which he is largely respon-

sible. These dies are shown in the illustrations. The dies for making valve rod keys, shown in one of the line drawings, are used in the 300-lb. Bradley hammer, but will do the work intended for them on a much lighter hammer. Two sizes of keys can be made on the one die. The keys are made from scrap material and the operation requires ony one heat. Two of the sketches show dies for the Bradley hammer on which are made flat cape and round nose cold chisels and beading tools with round and hexagon shanks. Another sketch shows the dies used on the 4-in. forging machine to make grease plugs for side rods. The plugs are made in one heat and three operations from 1¼-in. square iron.

Some of the work handled in the shop

New main and side rods are made from single billets, no welding being permissible. The rods are made from either carbon steel, or carbon-vanadium steel, ordered to the latest issues of the New York Central Lines specifications. If scrap carbon steel driving axles are available, they are used for such small carbon steel rods as can be made completely therefrom, provided they are free from defects and that the chemcial composition has been approved by the local assistant engineer of tests.

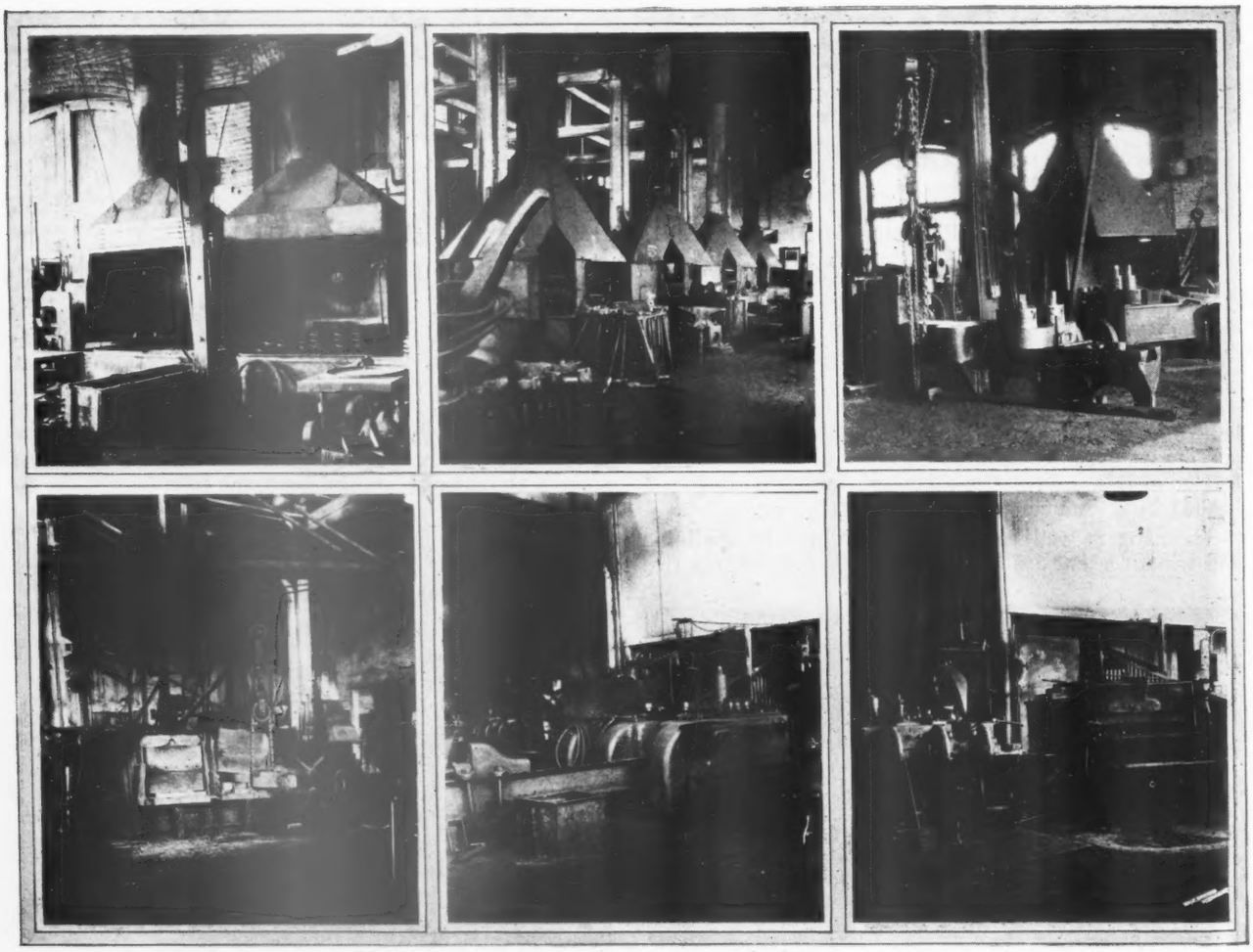
It is not permissible to repair main or side rods defective from a fracture or break. Such rods must be scrapped. A rod slightly bent, not to exceed 5 deg. at any point, is heated very slowly at the bend to not more than 950 deg. F., and then it is straightened. After straightening, the rod is normalized. A rod badly bent over 5 deg. is heated very slowly at the point of bend to not more than 1,525 deg. F. and straightened. After straightening, the rod is normalized.

The heat treatment of side rods

Carbon steel, carbon-vanadium steel billets or blooms are heated slowly and uniformly to a temperature of 1,900 deg. F., which corresponds to a light yellow color in the diffused daylight of the forge shop. Cold billets or blooms are not charged into a hot furnace. All new carbon steel, or carbon-vanadium steel forgings and all repaired carbon steel and carbon-vanadium steel forgings are normalized or air annealed after forging, straightening, etc., is completed.

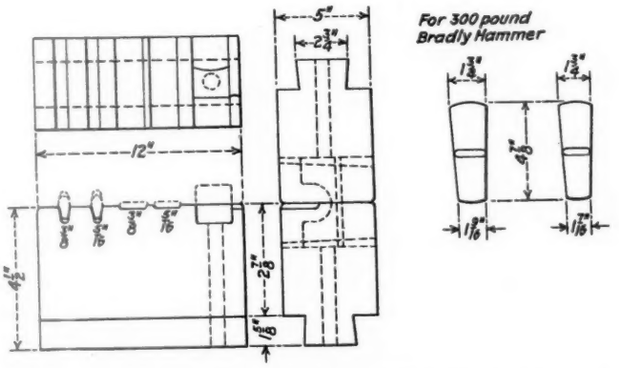
In charging forgings into the furnace or normalizing, all long rods, etc., are placed on edge and properly supported every 3 ft., on iron blocks to prevent warping or sagging. The forgings are not piled one upon another and are separated sufficiently (at least 3 in.) to permit free circulation of the furnace atmosphere to all parts of the forging.

The forgings are reheated slowly and uniformly in the furnace to a temperature at which scale will just form on the metal. This temperature is 1,500 deg. F. to



Upper left—Furnaces used for heat treating springs; Upper middle—Part of the 17 blacksmiths' forges; Upper right—The stock adjusting machines; Lower left—Rod furnaces; Lower middle—The 4-in. Acme forging machine; Lower right—The 1½-in. Acme bolt header

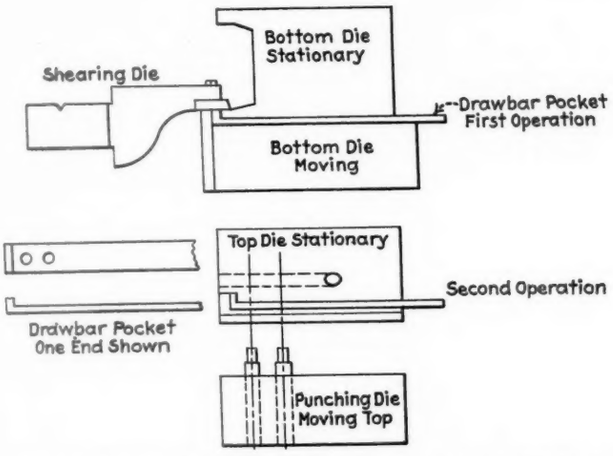
1,600 deg. F., which corresponds to a light or bright cherry color in the diffused daylight of the ordinary



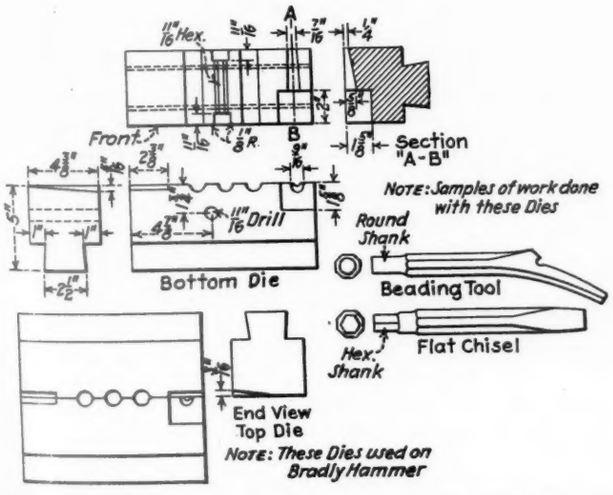
Dies for making valve rod keys on a 300-lb. Bradley hammer

forge shop. The flame in the furnace is not permitted to play directly on the forgings.

After the forgings have been brought uniformly up to



Dies that lip and punch holes in 4 in. by 1 in. and 5 in. by 1 in. draw pockets—The dies are used on a 4-in. forging machine



Dies for making beading tools with round and hexagon shanks

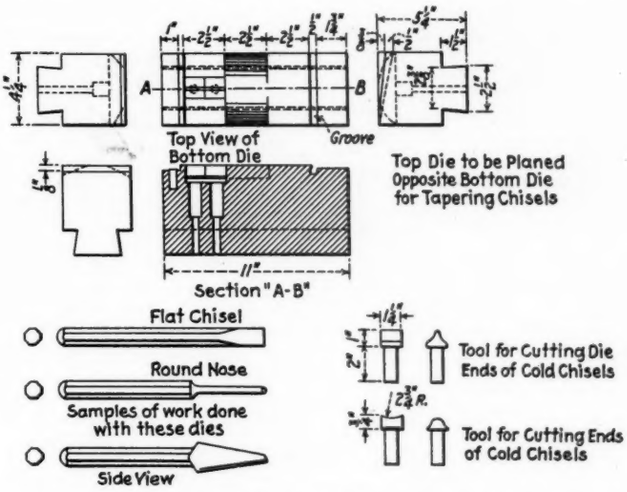
heat, they are held at temperature for at least one hour per inch of diameter or thickness, then removed from the furnace, separated at least 6 in. and allowed to cool freely in the air, protected from rain or snow. Under no circumstances are forgings quenched in water or any other cooling medium.

Autogenous welding is not used upon any rods or

List of equipment installed in the West Springfield blacksmith shop

No.	Equipment	Purpose
17	Forges	Hand forging
3	Portable oil furnaces	Frame welding
1	Ferguson double door furnace	Supplies 5,000 lb. hammer
1	No. 5 furnace	Supplies 4-in. Acme forging machine
1	No. 3 furnace	Supplies 1½-in. Acme bolt header
2	Oil furnaces, 24 in. by 12 in.	Heat treatment
1	Double door furnace, 8 ft. by 3 ft.	Spring repairs
2	Oil baths, 6 ft. by 25 in. by 24 in.	Cooling springs
1	Oil vat, 18 in. in dia. by 12 in. deep	Cooling springs
1	Oil furnace, 4 ft. by 2 ft. 6 in.	Small work
1	Double door furnace, 5 ft. by 3 ft.	For hammer
1	Single door furnace	Annealing
1	Oil furnace, 24 in. by 14 in.	Cyanide casehardening
1	Underfired furnace	High speed tool steel
1	Oil furnace, 36 in. by 18 in.	Tool steel
1	Oil furnace, 26 in. by 12 in.	Tool steel
1	Lead pot furnace, 8 in. dia., 14 in. deep	Carbon tool steel
1	Oil furnace	Drawing temper
1	Furnace, 10 ft. by 3 ft. 6 in.	Annealing large parts
1	Oil furnace, 3 ft. by 16 in.	Small work
1	Ferguson oil furnace, 12 in. by 24 in.	Small pieces of tool steel
1	Oil furnace, 24 in. by 10 in.	Beaudry hammer
1	Oil furnace, 18 in. by 8 in.	Bradley hammer
1	Oil furnace, 18 in. by 12 in.	1,200-lb. hammer
1	Steam hammer, 5,000 lb.	Rod work
1	Steam hammer, 2,500 lb.	
1	Steam hammer, 2,000 lb.	
1	Steam hammer, 1,200 lb.	
1	Steam hammer, 700 lb.	
1	Beaudry hammer, No. 9	Small tools
1	Bradley hammer, No. 8	Small tools
1	Ryerson spring bander	Springs
1	Air operated band press	Springs
2	Air operated spring assemblers	Springs
1	Bulldozer, 5 tons	Car work
1	Acme forging machine, 4 in.	Die work
1	Acme bolt header, 1½ in.	Staybolts, etc.
1	Shear, 4 in. stock	
1	Hand bending machine, ¼-in. stock	
1	Hilles & Jones shear, 2½ in. stock	
1	Shear, ¼ in. to 1 in. stock	Supplies bolt header
20	Cranes, 1 to 5 tons	
1	No. 9 Sturtevant blower	Supplies oil furnaces
1	No. 7 Sturtevant blower	Supplies small forges
1	Stock adjusting machine	Miscellaneous work

motion work but may be used to fasten grease cup bushings in place. The welding torch is not used for the purpose of removing metal from side rods, main rods,


A
B
Top View of Bottom Die
Groove
Top Die to be Planed Opposite Bottom Die for Tapering Chisels
Section "A-B"
Flat Chisel
Round Nose
Samples of work done with these dies
Side View
Tool for Cutting Die Ends of Cold Chisels
Tool for Cutting Ends of Cold Chisels

Dies used on a 300-lb. Bradley hammer for making flat cape and round nose cold chisels

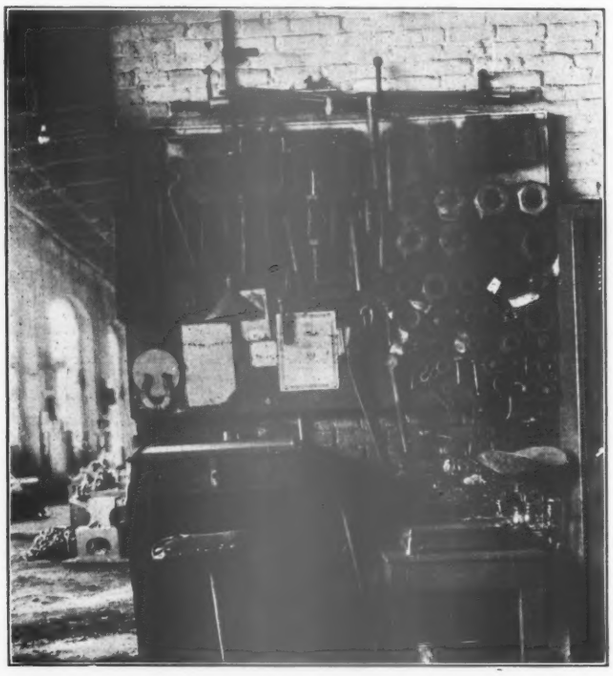
guides, crossheads, motion work or crank pins for the purpose of obtaining the proper clearance or a method of quick repairs.

Side rods are scrapped when the knuckle joint pin bushing holes exceed the new diameter by more than

5/16 in. The diameter of the pin must be maintained constant at all removals of the pin.

The heat treatment of small tools

Such small tools as large reamers, milling cutters, etc., are made in the tool room from old axles and then sent to the blacksmith for heat treatment. The tools are packed in Carbo-Pearlite and heated for eight hours at a temperature of 1,500 deg. F. They are then allowed to cool off over night in the carbonizing box after which they are repacked in the same material and held at a temperature of 1,500 deg. F. for seven hours and then removed and quenched in salt-water for four hours in



Some of the work turned out on the 4-in. forging machine

an oil vat. The tools are then held for four hours in an oil bath at a temperature of 400 deg. F. and cooled off. This method of heat treating tools has given very good results. All of the furnaces used for heat treatment are controlled by pyrometers.

Repairing springs

Two blacksmiths, each with a helper, repair all locomotive and car springs for the entire road. Recently, all hand work has been eliminated by the installation of modern spring machinery. The usual method of repairing springs is employed. The leaves are heated to 1,550 deg. F., removed from the furnace and reset to a master leaf. They are then put in an oil bath for 15 min. and then put back in the furnace and drawn to the correct temper.

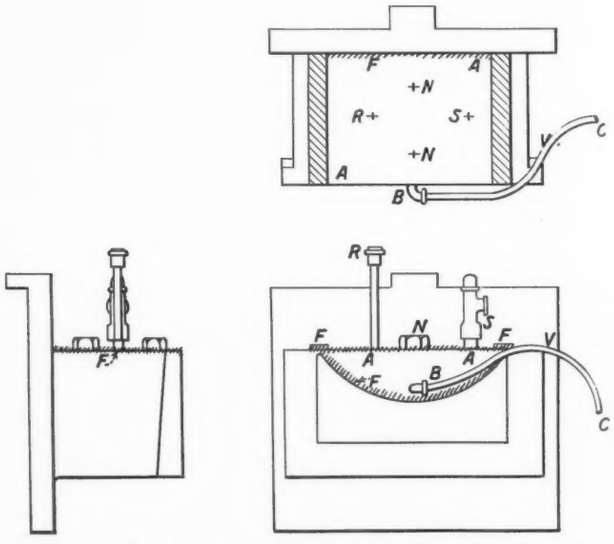
Softening grease on a cake forming machine

By A. T. E.

DURING the past year a number of railroads in this locality have been using a driving box journal grease which is considerably harder to work through the forms of a grease cake machine than the kind of grease which was formerly used. When the grease is pressed through a cold form, there is a tendency for the cake to break and the grease to stick to the sides of the form. Furthermore, it requires considerably more time to run this grease through the machine. A number of railroad shops have used a heating device usually made of steam pipe coils placed under or around the form to overcome this difficulty. None of these devices, however, have seemed to work as satisfactorily as the arrangement shown in the sketch.

The casting *A* fits over the top and down the front of the form in such a manner as to form a steam tight box integral with the form itself. The edges of this casting, where they come in contact with the form, are machined or cleaned to allow the machine to be welded for a steam tight joint. Two holes are tapped in the center of the concave face of the cast iron form for the studs *N*. These studs are welded in place after the plate has been drilled and the nuts on the studs are tightened to hold the plate down so that they serve as additional safety stays. The plates are then built up by welding around the ends to obtain increased strength.

Previous to drilling the holes for the studs *N*, the plate was drilled and tapped at the points *R*, *S* and *B* for pipe fittings and for the safety valve *S*. Steam is admitted through the pipe *R* and is allowed to escape through the pipe *B-C*. A valve located in the pipe *B-C* at *V* is used to retain steam pressure in the heater box. The safety valve *S*, which serves as a warning to the operator if the pressure becomes too high, is set at 10 lb. per sq. in. pressure. The irregular cross hatch-



Sketch showing the application of the heater to a Franklin grease cake machine

ing shown on the surfaces of the box and form indicate the places which were built up by welding. The hole for the safety valve is tapped for a ¾-in. pipe connection and the holes for the pipes *R*, and *B-C*, are tapped for ½-in, pipe connections. The studs *N* are ⅝ in. in diameter. The points *F* shown on the sketch indicate the places which were finished before welding was started.

Several of these heater boxes have been in service on different types of grease cake forming machines for over a year. The cakes of grease come through the forms perfectly smooth and the time consumed for doing the work is considerably less than when doing the work without a heater.

C. M. & St. P. blacksmith shop kinks at Tacoma

THE Chicago, Milwaukee & St. Paul blacksmith shop at Tacoma, Wash., the western terminus of the road, is called upon to furnish forgings, pressed steel shapes and springs for a large territory, and is therefore equipped to turn out large quantities of these kinds of material. Forging machines, bulldozers and air-operated machines, facilitate the work.

A good example of the fixtures and devices used to

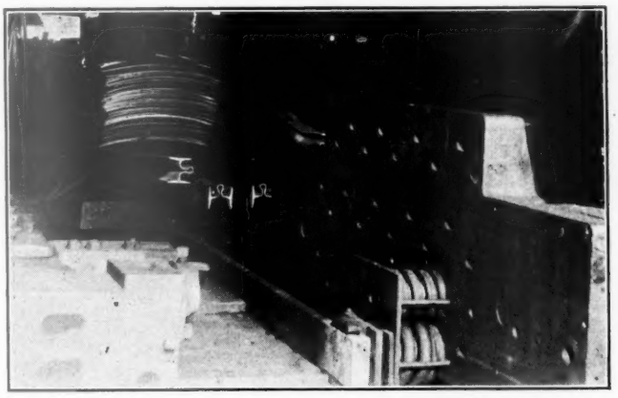


Fig. 1—Ready to punch the first holes in one end of a coupler yoke bar

save hand labor in forging is afforded by the method of manufacturing coupler yokes. A straight section of bar stock of the required dimensions is upset on each end in a forging machine to form the lips or shoulders which engage corresponding shoulders on the coupler

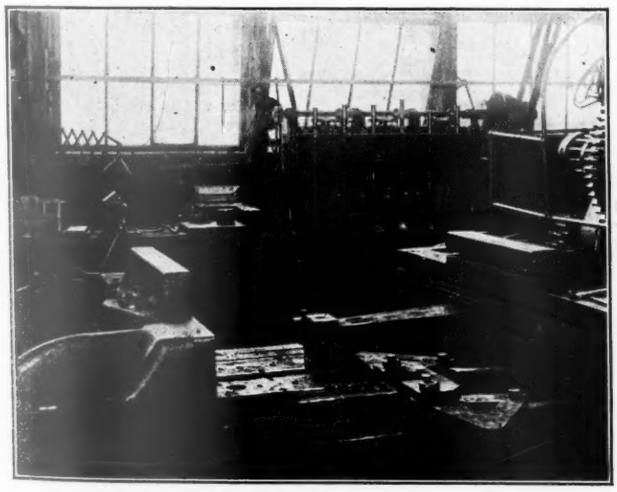


Fig. 2—Bulldozer set-up for making two right-angle bends simultaneously in a straight bar to form a coupler yoke

shank. The bar with the two upset ends is then taken to a bulldozer, set up as illustrated in Fig. 1, and two holes are punched in one end, after which the bar is drawn across the table to punch two similar holes in the other end. A single stroke of the bulldozer with the bar placed on the top jaw punches the center hole. The return springs push the bar away from the punch after each stroke of the machine, suitable stops assuring the location of punched holes at the proper points without the necessity of making measurements on each bar.

The final operation consists of bending the bar in the form of a yoke by means of a bending former plainly illustrated in Fig. 2. The bar is located centrally with respect to this former and a single stroke of the bulldozer effects the two right-angle bends, forming the straight bar into a U-shape which completes the yoke. Pins which connect the arms of this bending former to the former proper are of the eccentric type, by means of which adjustments can be made to form 6½-in.,

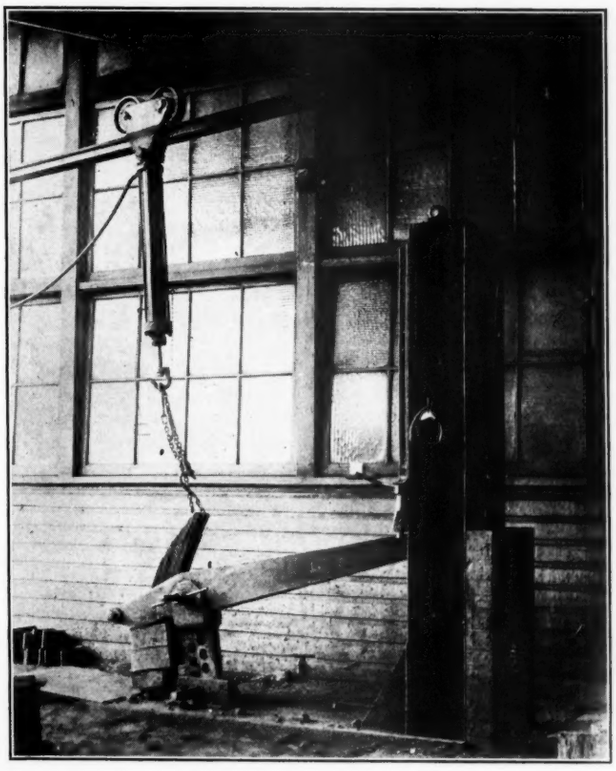


Fig. 3—Air-operated spring stripping machine at the Tacoma shops

8½-in., or 9¼-in. yokes, the eccentric being held in a different position by means of a dowel pin.

A spring band stripping device used at Tacoma blacksmith shop is illustrated in Fig. 3. This is an air-operated device of ample power for the work intended and with adjustments as indicated to take care of different sized springs. After each spring is heated to a dark red in the small oil furnace, shown on the left, it is taken to the machine and dropped into a pocket which holds the spring upright, the cylinder and lever when in the downward position being swung back out of the way so that the spring can be easily placed in the pocket. The lever, consisting of two plates adjustable to different spring widths, is then pulled ahead to straddle the spring

above the band. The wing nut and bolt, which acts as a pivot, and the bolt inserted in the end of the lever, prevent the two plates from spreading when pressure is applied and the band forced off as far as the lever travel will permit. A U-shape is placed on top of the band and another stroke of the machine completes the stripping operation. The illustration shows a spring which has just been stripped. The jib crane and pneumatic hoist facilitate handling heavy springs.

Complete spring assembling machinery is available at this shop, the forming rolls used being illustrated in Fig. 4. The spring leaves are given the proper camber and fitted to one another on this device. A pneumatic spring banding machine arranged with two 18-in. air cylinders to apply pressure horizontally and vertically is used. The lever arrangement of this machine, with a ratio of 1 to 12, gives a pressure of 121 tons per ram available when necessary.

Fig. 4—Forming rolls used in giving spring leaves the proper camber

Method of keeping a record of driving box repairs

By J. A. Pullar

Driving box foreman, St. Louis-San Francisco, Springfield, Mo.

ORDINARILY, it requires several books to keep accurate records of driving box repairs. This difficulty can be eliminated by using the form shown in the illustration. This record can be kept in a book with sufficient pages to cover a month's repairs. At the end of each year the amount of driving box repairs made during each month can be readily determined by referring to the books. This system has been in use several years with excellent results in the driving box department at the West Springfield shops of the Frisco.

JAN. 1925

DRIVING BOX RECORD — FRISCO WEST SHOP

ENG. NUMBER	DATE OK	TURN JOURNAL	NEW BOXES	NEW AXLES	NEW BRASS	NEW CELLARS	FRANKLIN WEDGES	HUB PLATES	CHRISTMAN HUB PLATE
1298	1-7-25		8	4	8	8	1-7-25	4	
40	1-9-25		0	5	10	10		0	
41	1-10-25	1&4	0	2&5	10	10	1	0	
862	1-12-25	2&3	0	No.1	6	6		0	
627	1-13-25	2&3	0	No.1	6	6		3	
640	1-14-25	No.2	0	1&3	6	6		2	
766	1-15-25	No.1	0	No.3	6	6		5	
1511	1-17-25	2,3&4	0	No.1	8	4		0	
587	1-18-25	2&3	0	No.1	6	6		2	
1057	1-21-25	2&3	2	0	6	6		1	
1243	1-22-25	No.4	0	1&3	6	8		1	
188	1-23-25	1&2	0	0	4	0		4	
1512	1-26-25	1,3&4	0	0	8	8		0	
29	1-27-25	1,3&5	0	No.4	10	10		0	
1039	1-23-25	No.1	0	8	6	6		2	
4007	1-28-25	No.2	0	0	8	8			
1012	1-29-25	6	6	1	6	6		6	

Compact form for keeping a record of driving box repairs

Supplying fuel oil to locomotives

By C. W. Geiger

A LARGE underground storage tank of concrete is maintained by the California State Harbor Board, San Francisco, Cal., for supplying fuel oil to the locomotives operated by the board on the San Francisco water front. Ordinarily the fuel oil is pumped from this tank by an electrically driven oil pump, which is located in a fireproof building built above the tank. The pipe connections used for delivering the fuel oil to the tender are located at the end of this building as shown in the illustration. In addition an emergency system has been devised for delivering fuel oil to the locomotives by compressed air in case the oil pump should get out of order, the method of operation of which is shown in the illustration. A small storage tank has been placed at a level so that oil will run into it from the main storage tank by gravity. To lift the oil from this tank the operator turns a valve which allows compressed air to enter at the top of the tank which forces the oil through the pipe extending up out of the ground to the delivery pipe.

Turning the valve in the compressed air line forces fuel oil from the emergency tank to the delivery pipe

New B. & M. boiler shop at Billerica

Increases ground floor space of locomotive shop by 64 per cent—Shop operation improved

FOR several years the need has been apparent for larger space for the more expeditious handling of locomotive repairs at the Billerica shops of the Boston & Maine. Restrictions had become serious with the increasing number of the heavier types of locomotives coming to the shops for general repairs and the greater amount of boiler repairs due to new firebox requirements. In addition, owing to the lack of sufficient aisle space in the machine shop, the manufacture and repairs to rods and the repairing of engine trucks, boosters, feedwater heaters, stokers and power reverse gears, were being performed under adverse conditions. Furthermore, the noise of the boiler shop was more or less undesirable in the erecting and machine bays of the main shop.

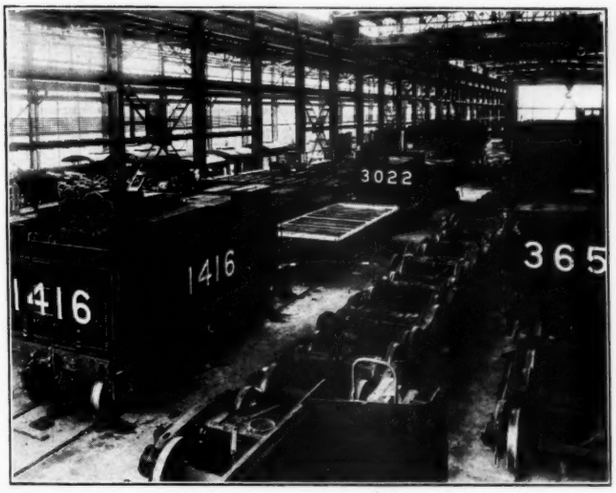
Looking towards the heavy boiler machinery section

The end of the middle bay in which the boilers are repaired

In order to correct the existing undesirable conditions, an addition measuring 572 ft. by 151 ft. on the south side of the locomotive shop, has recently been constructed in remarkably quick time by Dwight P. Robinson & Co., New York. Pile-driving work for the foundation piers was begun September 7, 1926; erection of steel work began October 30, and the building was closed in by the end of December. The contractor's building work was practically completed for occupancy the latter part of January. The moving in of machinery from the old shop was begun the last of January and the occupation completed February 21, with locomotive repair work already under way. The new building increases the ground floor space of the locomotive shop by 64 per cent. The cost of the improvements amounts to approximately $500,000.

Construction of the building

The new building is constructed in three long bays. The bay adjoining the erecting shop is 32 ft. wide and has a low roof, permitting the admission of daylight to the old shop through its upper windows. This section provides for the tube work, machinery for sheet metal work, tender truck repairs, brake rigging and pipe jobs, and also accommodates a toolroom, foremen's offices and toilet facilities.



The middle bay where trucks, tenders and boilers are repaired

The middle bay is 79 ft. wide and is sub-divided into 26 bays, 22 ft. wide between centers. Two electric traveling-bridge cranes, one of 35 tons hoisting capacity and the other of 25 tons capacity, operate the entire length of the building on rails 33 ft. above the floor, permitting the handling of boilers, tenders and trucks with ample head room. Boiler repairs are made at the west end of the bay, tender repairs in the middle section and tender frames and truck repairs at the east end of the bay. Space is provided for 12 tender frames and 12 tenders.

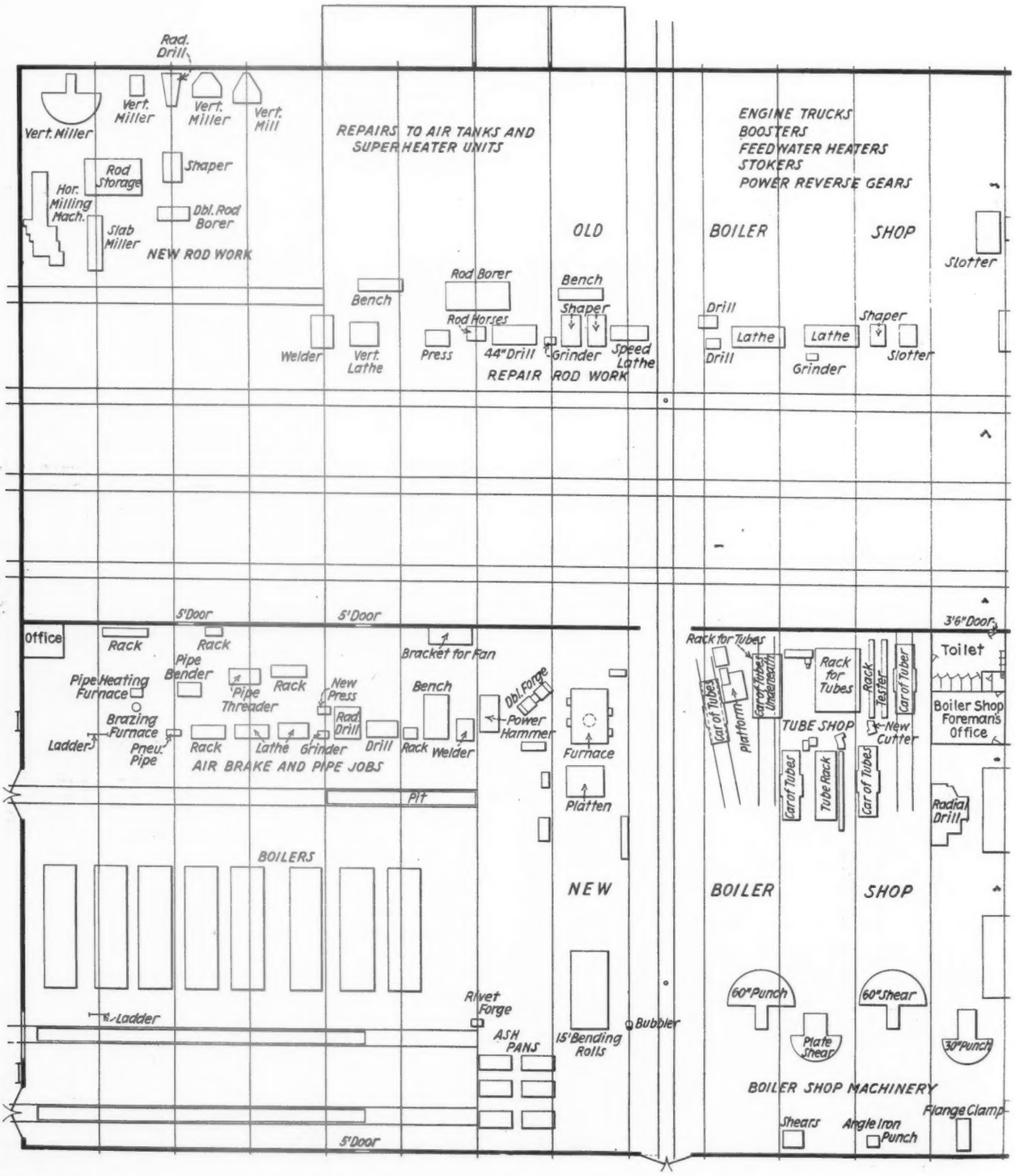
In the third, or outer bay, which is 40 ft. wide, a 10-ton crane travels on tracks 22 ft. above the floor. Here repairs are made to trucks, cabs and ash pans.

Two tracks, each accommodating two locomotives, enter at the west end, where locomotives are fired up for final tests and inspections. Smoke jacks or funnels provided with telescopic pipes are pulled down over the stacks to carry off all smoke and gases during the firing operations.

The new building has an abundance of day lighting afforded by the extensive use of glass in the outer walls and roof monitors.

Facilities in the new shop include steam, water, compressed air and oil pipe connections, as required at various points, as well as electric lighting and power circuits for extension lights and small power tools. Provision is also made at convenient locations for electric and oxy-acetylene welding operations. The acetylene and oxygen is supplied from a central station.

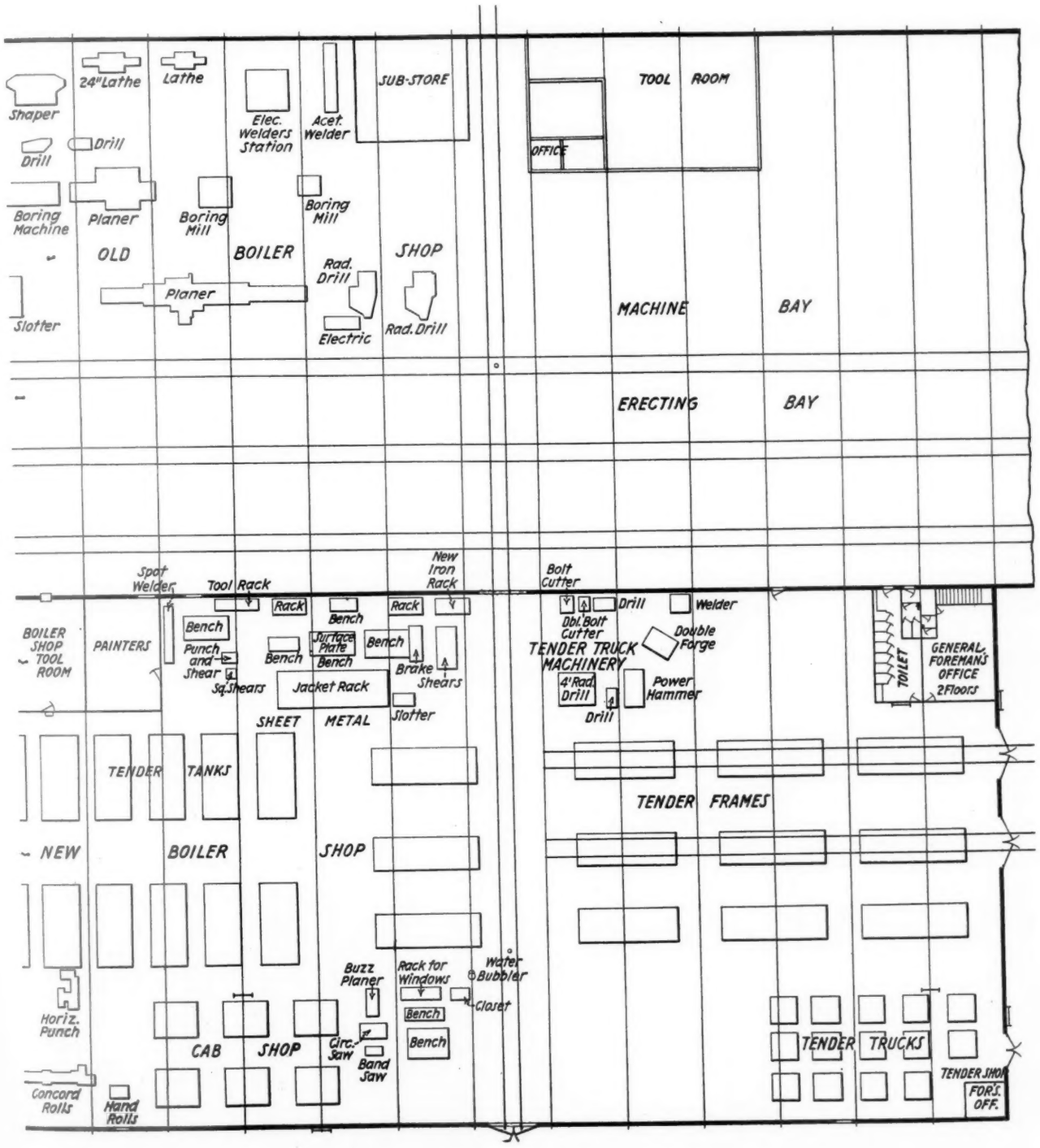
The building is heated from pipe coils by a hot-water



Floor plan of the west end of the shop showing the location of the machine tools in the new boiler shop and the machines in the old boiler shop

circulating system, an extension of that already provided for in the main shop.

A relocation of accessory structures was required and a small building adjoining the shop has been constructed for lye vats in which machinery parts are cleaned, also located on the balcony over the machine bay has been transferred to the boiler shop. All of the machines have been set on concrete foundations and equipped with individual motor drive. No new machine tools have been placed in the new boiler shop.



The east end of the shop showing where the tender tanks, tender trucks and tender frames are repaired

open sheds erected for the storage of parts removed from locomotives while not undergoing repairs.

The machines in the new boiler shop were transferred from the old boiler shop and other departments. The tin shop and some of the cab shop machinery formerly

Changes made in old boiler shop

The old boiler shop that was formerly located along the northwestern end of the main shop has been made a part of the machine bay. Old machine tools have been removed from the original machine bay and the balcony

and relocated and motorized in the new section. Some new machines have been installed. The machine tools required for making new rods and repairing old rods are now located at the extreme western end of the machine bay. Then follows the section set aside for repairs to air reservoirs and superheater units. Then comes the necessary space and machine tools required for

The two tracks where the locomotives are fired up and receive final inspection

making repairs to locomotive auxiliaries, such as boosters, feedwater heaters, stokers, etc. Each machine tool now has ample storage space which has resulted in a decided increase in production. Furthermore, the relocation of the machine tools has relieved the overcrowded machine bay for other operations.

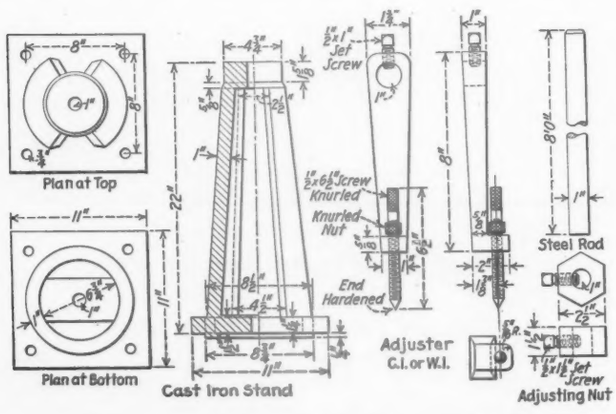
Gage for alining smoke stacks on locomotives

By H. H. Parker, Jr.

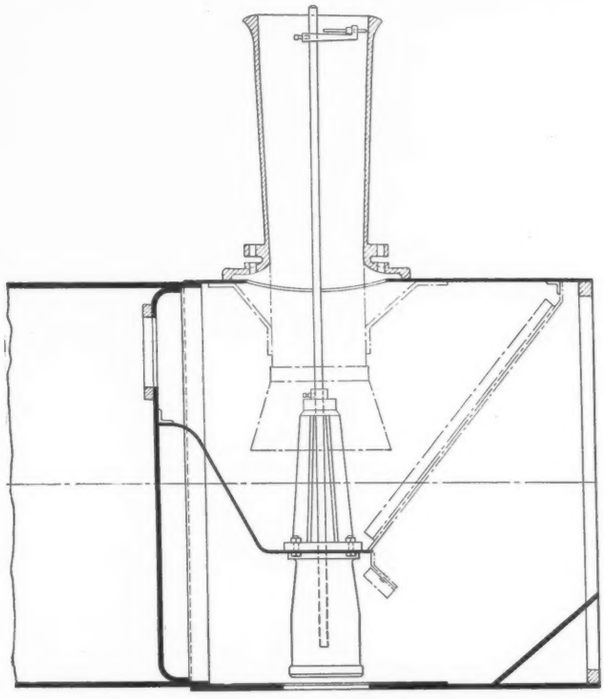
Shop draftsman, Norfolk & Portsmouth Belt Line, Portsmouth, Va.

IT is essential in order to secure the best results when a locomotive is in operation, that the stack, base and smoke box extension be in perfect alinement with the exhaust nozzle. The Norfolk & Western Belt line has a home-made device, shown in the two drawings, with which a mechanic can quickly line up a new stack and have it ready to fit to the boiler in less time than usually required to get the jacks ready for leveling the stack.

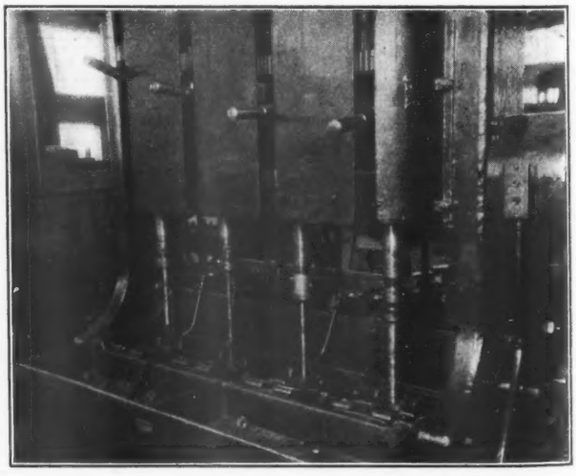
This device consists of a cast iron stand 22 in. high, as shown in the detail drawing, a 1-in. round steel or iron rod, 8 ft. long, and adjusting nut with a ½-in. set screw and an adjuster as shown. This device can be made in any small shop at comparatively low cost, the stand being the only part that has to be cast. All that is necessary to line up the stack with this device is to remove the exhaust nozzle tip, clamp the aliner on the exhaust stand, set the adjuster and revolve the rod. This method has proved to be a time saver over the old way. The aliner is kept in the tool room, is light in weight and does not take up much room.



Detail construction of the smoke stack aliner



Method of alining the stack with the nozzle by means of the gage



A nut tapper threading 1 in., ⅞-in., ¾-in. and 1½-in. nuts at the same time

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

One method employed for stripping locomotives

DETROIT, Mich.

TO THE EDITOR:

Recent issues of the *Railway Mechanical Engineer* have carried articles on the subject of different methods used for stripping locomotives. The following brief outline of the locomotive stripping methods employed in a large mid-western shop is not submitted as a highly perfected system, but merely as one which has served its purpose for a considerable length of time and will continue to serve it until the question raised in the article on page 469, in the August, 1926, issue of your paper, results in the production of a more satisfactory system.

Engine mileage does not entirely govern the stripping of locomotives. Eye training and good judgment are two essentials needed when rendering decisions on parts which will not have to be removed. Many times new bushings and parts have been applied by engine-house forces previous to locomotives entering the shops and we do not think these should be renewed unless necessary to make the mileage required.

Boiler work governs the output, therefore this is considered first, with the front ends given the preference. Front end doors are opened and left suspended on the smoke boxes by Okadee door hinges.

Steam pipes and headers are not removed except when conditions warrant, as outlined by the road inspector's reports. These are carefully examined, then tested when the units are applied. There has been but one steam pipe removed in the past twelve months on account of leaky joints. Steam pipe packing flanges are removed to rejoint and repack. Upper portions of serviceable smoke stacks which need rejointing are removed. If no work is required, they are not disturbed.

The rods, wheels and motion parts are next considered. Rod bushings are examined carefully. Each good bushing is noted and a careful check is made of the crank pin to determine if it is within limit variations, a copy of which the inspector has become familiar with.

Wheels and boxes are removed. Decisions on crown brasses and hub liners rendered are then handled by the wheel department. Crank pins are checked by an Ashton quartering gage. Crank pins and axles are pressed off only where conditions warrant. The cleaning department is located directly back of the stripping pit. This simplifies the handling of heavy parts.

Motion parts that will run another mileage are not removed. Guide bars are checked by gages and straight edges. Thirty per cent of the guide bars are found to be in good condition. The stripping of back cylinder heads is governed by the road inspector's or foreman's report when other conditions do not require them to be removed. Back valve heads and guides are not removed unless necessary but are repaired by the erecting forces.

The ash pans are examined. Fifteen per cent are found in good condition.

Spring gear parts are checked carefully. Parts which do not show wear or which can be repaired in their places are not removed.

As a rule, cabs and running boards are removed only on engines receiving heavy fire box work or stoker removals, as they can easily be repaired or tightened in place.

Boiler steam valves, lubricators, gages, air brake equipment, injectors, boiler checks, trimmings, bell ringer cylinders, superheat damper cylinders, main throttles, steam valves, whistles, generators, blow off cocks and washout plugs are removed and tagged by one man. This eliminates misplacing and wrong tagging of material. All pipes removed are handled and tagged by one man. Pipe clamps are fastened on the pipes to which they belong.

Air compressors, water pumps and tube bundles, air reverse gears, stokers and other appliances which have internal works are always removed unless the road inspector or foreman's report specifies them to be in good condition, which is infrequent. Brake cylinders between the frames are not removed but are repaired by the erecting forces. It costs more to remove and replace them than the repair labor amounts to.

Jackets in good condition over the barrel portions of boilers are not removed unless external boiler inspection is required or other bad boiler conditions exist.

Sand boxes are not removed, as they can easily be tested and repaired in their places but must always be emptied before being sent to back shops. Bell frames and yokes are not removed unless heavy repairs are required. Air drum brackets, pump brackets, reverse brackets, etc., are examined carefully and if found in good condition are not removed from the boilers, but all air drums are removed for hammer test when due.

Trailing trucks not equipped with boosters nor needing heavy repairs can easily be repaired without removing. Engine trucks are removed and stripped unless the road foreman's report states that they are in good condition, which is of infrequent occurrence.

"OBSERVER."

A. R. A. Rule 66—An Opinion

MINDEN, La.

TO THE EDITOR:

It seems to me that A.R.A. Rule 66 will only be workable under conditions similar to those in Rule 60, and the car owner be made responsible when it becomes necessary to repack all the journal boxes, regardless of stenciled date; the billing repair card for such repacking of "In date" cars to be used as joint evidence of wrong repairs in accordance with Rule 90, against the road that applied the last stencil date.

Subsequent repacking by the same road within the twelve-month period, when necessary, should be the handling lines responsibility and the billing repair card

rendered, marked "No bill," which would be of great value in checking the maximum period that the journal boxes may be expected to run between journal packing dates.

This should eliminate the tendency to stencil cars "In date" without actually performing the work as prescribed by the rule, as is being done in a great many cases. I am quite sure that no railroad wishes to repack the other fellow's cars as a source of revenue, as the line between a credit and a debit is too finely drawn, when the work is performed in compliance with the rule.

J. B. Searles.

Was Jack right?

Michigan.

To the editor:

I wonder if you would care to start a discussion in the *Railway Mechanical Engineer* on the following incident which actually occurred in a well-known railway locomotive repair shop.

In this shop, the force of which consisted mostly of organized railway mechanics, the standard rates of pay were being paid all mechanics, namely 75 cents an hour, and classified according to the National Agreement. In one department, a certain man proved more capable and turned out much more work on his machine than any other. This was not at all because the other men were not doing their best, but he seemed to have a genius for making each cut tell and every move he made or tool he shaped was for the better. Strange to say, this did not make him at all unpopular with his fellows as is usually found to be the case among workmen. But his foreman, after getting him an increase through the necessary channels of five cents per hour as a recognition of his ability and willingness, received the shock of his life.

The following is the dialog which took place:

"Say, Jack, I noticed for several months that without any special urging you have been turning out more work—and of equally as high quality—than any other boring mill operator we have and I have got a raise through for you to show you how I appreciate an extra good man when I find one."

"Well! I thank you for your good opinion, Mr. Smith," said Jack, "but I am not doing that merely for an extra rate. I'm just doing the best I can, as I always have done wherever I have worked and I know the rest of the gang are doing the same. They are all good friends of mine and if I accepted that raise, some would be sure to get sore, perhaps at me, certainly at you or the shop and the result would be a certain amount of dissatisfaction. Unless you can give them all an increase, I'd rather not take one. I do not wish to be the only one getting 80 cents per hour. I like this shop and want to work here under the present conditions. The last shop I worked in paid varying rates, and I quit on account of the bitter feelings and soreness existing throughout the whole plant. Some hated the bosses and I guess some hated themselves, just on account of the varying rates they were being paid, so just do your best to get us all a little more and let what little extra you may get out of me help out the guy who can hardly make the grade."

"Then, do I understand you to really mean that you do not want recognition of your ability?"

"Not in that way, I don't!"

"Well, how else can we show our appreciation?"

"Well, I'm quite young yet and some time you may be looking for a foreman. You might then give me some consideration."

"Well, Jack, I'm sorry you refuse this and the reason you give me for it simply puts you out of the class of foreman material. You're too much afraid of what the other fellow thinks to ever make a highly successful foreman."

"Well, Mr. Smith, I don't wish to get into any argument with you on handling men, but I think methods have changed greatly during the last few years. Yes, I may as well say it, since the craftsmen's strike of 1922, and perhaps in view of this, I am not so much mistaken in being concerned with what my associate workmen think of me. We are now striving to establish close intimate relationships among ourselves and our foremen, and picking one out of a whole department for a higher rate will not help it along."

Question—Is Jack poor foreman material and should he have accepted the increase offered him?

"Corporal Smith."

Substituting forged steel for cast iron yokes

New Haven, Conn.

To the editor:

In a letter on the Readers' Page of the May issue of the *Railway Mechanical Engineer* by "A Reader," a 1¼-in. by 5-in. riveted wrought steel yoke can be substituted for a cast iron cross-key yoke, whether or not the bar is stenciled for a cross-key yoke, without being considered wrong repairs. He further inquired whether A. R. A. Rule No. 17 covers this item.

A wrought iron riveted coupler yoke of 1¼-in. by 5-in. stock made in accordance with the specifications for A. R. A. standard coupler yokes (see the A. R. A. manual of standard and recommended practice) may be substituted for any defective non-A. R. A. standard coupler yoke, whether the bar is stenciled for cast steel or otherwise. When such a substitution is made, it is not wrong repairs unless such repair impairs the strength of the bar. A. R. A. Rule No. 17, section (a) covers this particular item in all detail.

James McDonnell,
New York, New Haven & Hartford.

The cutting torch

Minden, La.

To the editor:

Back in the days of the sledge and bar,
In making repairs to an engine, or car.
We split the nuts we couldn't turn;
With never a thought that iron would burn.
Ignorantly, blissfully, we hammered away;
Never doubting we earned our pay.
Drilling and punching out boiler stays—
Who wants to go back to those good old days?

While we sledged and sweated, it came to pass,
That iron could be cut with acetylene gas!
A man with a torch does more, by far,
Than a dozen men with sledge and bar.
And yet, this ointment contains its fly!
Afflicting the boss with a bloodshot eye.
'Tis the guy who waits from one 'til three,
For a torch to cut off a cotter key!

J. B. Searles.

Device for machine driving wheels

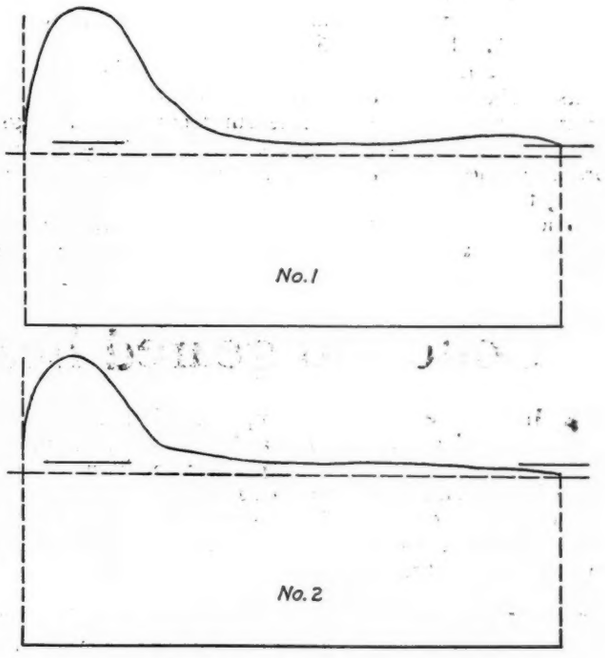
THE device shown in the illustration was developed and patented by E. F. Richardson, assistant to engineer of motive power, and Frank M. A'Hearn, assistant general foreman, Bessemer & Lake Erie, Greenville, Pa., for the purpose of turning driving wheel tires without removing the wheels from the locomotive. It is being marketed by the Universal Packing Corporation, 108 Smithfield street, Pittsburgh, Pa.

This device consists of a tool holder, weighing about

Device in operation—Brake cylinder pressure, 20 lb.

40 lb. and a cutting tool which has two cutting edges for right hand flanges and two cutting edges for left hand flanges. The tool holder is applied in the place of the driver brake head. The cutting tool is reversible, the same tool being used to cut either right or left hand tires and is made to conform to A. R. A. standard tire contours. The device is adaptable to any diameter of wheel and can be adapted to fit any brake arrangement on any locomotive. The double cutting tool furnished with the device is designed to remove the metal from high flanges and restore the contour of the tire. Special tools for removing metal from the tread of blind tires are also furnished.

The power for holding the cutting tool against the tire to be reconditioned is obtained from the locomotive brake. A 15 lb. to 40 lb. brake cylinder pressure is required. In using the device the tender brake and the driver brake on the opposite side of the locomotive is cut out and the driver brake piston travel is adjusted to 8 in. on the side where the device is to be used. The brake head is removed, the tool holder is applied in



No. 1—Contour of tire before turning—No. 2—Contour after turning—Total labor cost for turning the tires on a six-wheel switcher, $10.00

its place and the cutting tool is inserted in the slot of the tool holder. The driver brakes are then applied and the locomotive is moved forward, if the brake head is hung ahead of the driving wheel, or is moved backward if the brake head is hung behind the wheel. The locomotive may be run either under its own steam or may be towed. An even speed of not over three miles per hour should be maintained during the machining operation. The depth of the cut is regulated by the amount

of brake cylinder pressure applied. It is estimated that the cutting down of high flanges by this method can be done at the rate of ⅛ in. of metal per half hour at a cost of $2. This cost does not include the time the locomotive is out of service as the work of machining the tires can be done while the engine is awaiting assignment.

The following procedure is in vogue at one terminal where this device is used. When a locomotive has a flange that is above the I.C.C. condemning limit, it is put through the enginehouse and all other work, except turning the tire is completed. After the locomotive has been marked "O.K. for service" the wheel machining device is applied to the locomotive, which is towed along the running track until the flange is turned below the condemning height. It is reported that this device will restore the flange to its original contour in 30 min. using the power of the locomotive itself to do the work, thereby saving considerable hours of labor and returning the locomotive to service at an earlier date than if the wheels were removed for this operation.

Buffalo power horizontal punch

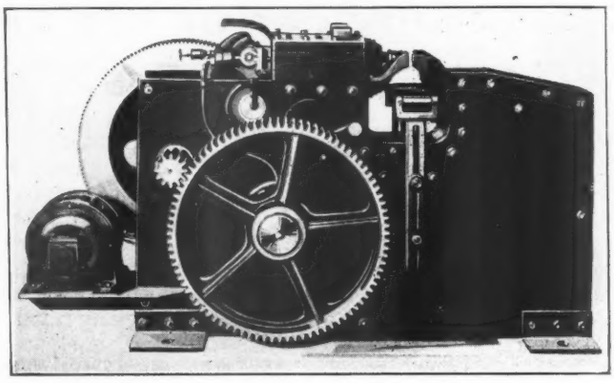
THE Buffalo Forge Company, Buffalo, N. Y., has placed on the market a horizontal punch designed for convenience in punching flanged pieces, boiler heads, curved angles, beams, channels and other shapes which cannot be handled to advantage by a vertical machine. All the gears, flywheel, etc., are below the top of the machine and do not interfere with the handling of any shape bent sections. The architectural jaws allow for punching close to the corners of angles. I-beams and channels in webs and flanges and of H-sections in flanges.

The Buffalo semi-floating punch head permits lowering the punch for the accurate locating of the centers. The punch is engaged by a foot trip. A cast-steel rocker arm on a bronze-bushed king pin, which is stationary in the frame, operates the punch. The frame is reinforced at this point by welded discs.

Wear of the ram is taken up by bronze-bushed eyebolts. The gibs on the plunger make it adjustable for wear. The gears are machine cut from steel castings. The pinions are steel forgings. All the bearings are bronze-bushed and the flywheel bearings are of the ring oiling type.

Since the work usually handled on this machine requires only a short throat, the standard machines are thus equipped. Larger throats can easily be made, since the "Armor-Plate" construction does not depend on castings.

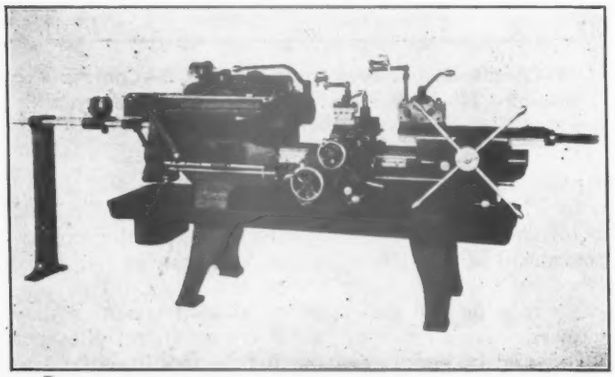
The machine is built in four sizes, with the following capacities: 1 in. by ⅝ in. and ⅞ in. by ¾ in.; 1⅛ in. by ¾ in. and 1 in. by ⅞ in.; 1⅜ in. by 1 in. and 1¼ in. by 1⅛ in.; 2 in. by 1 in. and 1½ in. by 1¼ in.



The Buffalo Armor Plate power horizontal punch

Cone and geared head type of turret lathes

THE Foster Machine Company, Elkhart, Ind., has placed on the market a No. 5 universal turret lathe, built in two types: an eight-speed all-geared head and a six-speed cone head, each having a bar capacity of 1 13/16 in. round through the automatic chuck, a swing of 17½ in. over the ways and of 9½ in. over the cross slide.



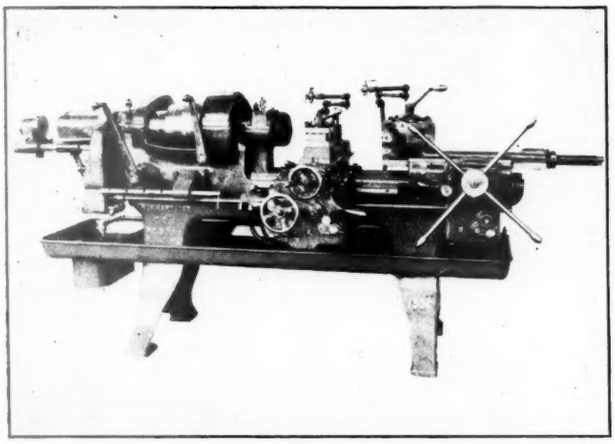
The Foster No. 5 geared head universal turret lathe

The cone head machine is provided with a three step cone pulley and back gears. Provision is made for the use of a 4-in. belt. The clutches are of the cone type, operated through a yoke and lever. The spindle is machined from an alloy steel forging, heat treated and is journaled in special bronze bearings. The hole through the spindle is 2⅛ in. in diameter and by placing the automatic chuck operating mechanism on the rear of the machine, the shortest overhang of the spindle nose possible is obtained, thus providing a rigid support to the collet or chuck. Through the use of the double friction countershaft regularly supplied with the machine, six spindle speeds and reverses are obtainable.

The geared head type provides eight spindle speeds through a heat-treated steel gear train and all speed changes may be made without stopping the machine. The speed changes are effected through multiple disc clutches and one sliding gear. All operating levers for controlling the speeds are located on the head of the machine and are conveniently placed for the operator. A separate clutch on the front shaft of the machine is provided for reversing the spindle, and the reverse action affects the spindle only. The spindle drive on the geared head machine is approximately twice that of

the friction head type. This machine can be supplied to be driven from a countershaft or directly from a motor mounted on the head, driving through a silent chain, or with a motor mounted on the rear leg of the machine, driving through a belt. A 3-hp. 1,800 r.p.m. motor is recommended for these drives.

The universal carriage is provided with six longitudinal feeds which are reversible. These are obtainable through a steel gear train, operating in oil, and likewise six feed changes are obtainable at the cross slide. Both the carriage and cross slide are provided with adjustable stops for automatically knocking out the feeding movements. The clutches controlling the feeding movements are fully adjustable from outside the apron. The cross slide is provided with a square turret which is detachable. This turret is machined from a steel forging and is provided with a ratchet mechanism to effect the indexing movement through the binder lever. Rocker blocks are provided for tool adjustment. The lock bolt for retaining the indexed positions is located directly beneath the tool in action.



Universal turret lathe with a cone drive

The hexagon turret is held central by a hardened steel stud pressed into the slide. A taper bearing is formed between the stud and a sleeve pressed into the turret. Provision is made for close adjustment of this bearing. The turret is designed for using either shank or flanged tools. The turret indexes automatically through the backward movement of the slide. A positive stop absorbs all shock from the indexing mechanism at the final indexing moment, which might be caused through the momentum of the backward movement of the slide. A taper gib on each side of the slide is supplied for the cross adjustment. Through six independent stop screws, the power feeds may be knocked out at any predetermined point. The effective turning movement is 10¾ in. and the maximum distance of the face to the spindle nose is 20 in. Six power feeds are available to the turret slide.

The automatic chuck is of the master collet type with bushings for each size and shape of bar. Either the drawing or pushout type of automatic chuck can be supplied and in either type, the extreme closing movement of the collet is through a toggle acting mechanism which effects a powerful grip to the collet.

The bar feed consists of a sliding stock head carried on two heavy parallel bars and operated through the same lever controlling the automatic chuck. The net weight of the friction head machine is 3,000 lb. and that of the geared head type is 3,155 lb.

Acme universal brass turret lathe

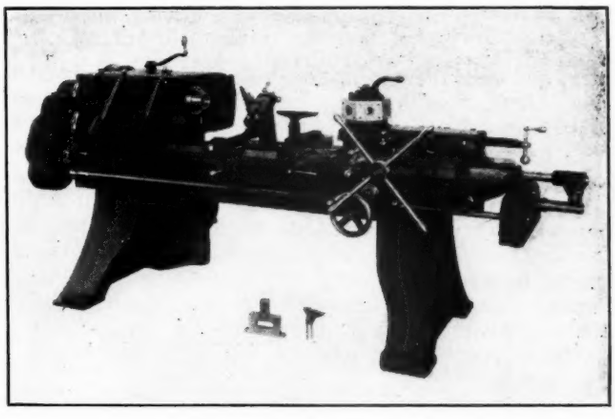
The new 20-in. full universal brass turret lathe, recently brought out by the Acme Machine Tool Company, Cincinnati, Ohio, is a modern development of the Fox and Monitor universal type brass lathes. It has been designed to offer a more flexible and universal machine to meet the demands for machining a variety of parts made of brass or similar metals; also to accommodate a larger range of work.

The head, which is cast solid with the bed to assure rigidity and permanent alinement, is regularly furnished with a three-step cone and friction back gears, providing two speeds for each cone step; or single pulley drive patented quick change all geared head, providing 12 speed changes, including forward or reverse.

The turrent is hexagonal in form and is provided with a quick acting lever which operates the lock bolt and binds the turret. The slide on which the turret is mounted may be quickly fed to and from the work by hand through the turnstile or slowly hand operated by a ball crank lever at the end of the slide, depending, of course, upon the nature of the work. A cross turret movement is also provided.

An outstanding feature is the design of the turret and cross slide saddle. To insure permanent alinement the flat ways on which the saddle was formerly mounted have been replaced with the vee type. The entire carriage may be traversed along the vees by hand or power feed. Another feature is the taper attachment for the turret. The adjustable taper guide below the bed slides between the vees and can be clamped in any position and removed when not in use. The design permits tapers to be turned by either hand or power feed.

A bed type chasing attachment is regularly furnished for chasing straight and taper right or left hand threads. One leader and follower is required for each size of thread. An apron type chasing attachment can also be furnished for the turret carriage for leading taps and dies and chasing internal or external right or left hand threads. The attachment can be used in conjunc-



The Acme turret lathe for brass work has the turret mounted on movable slides

tion with the taper attachment for chasing taper threads. The same leaders and followers are used as furnished with the bed type attachment.

To insure accuracy and long life of leaders and followers, the spindle revolves two revolutions to one of the leader driving shaft. This allows for the use of coarser pitch leaders and followers, giving greater bearing area. All aprons are so machined that the chasing attachment may be applied at any time. A hand rest saddle with hand rests of different lengths is included.

Modified 90-in. wheel lathe

MANNING, Maxwell & Moore, Inc., has placed on the market a redesigned Putnam 90-in. driving wheel lathe which has a capacity to turn wheels from 44 in. to 86 in. in diameter without the use of back carriages and from 28 in. to 44 in. in diameter with back carriages. The fewest number of gears and shafts have been used to obtain the desired range of speeds.

The faceplates have internal gear drive. Each faceplate has an opening for the crank pin and 12 radial tee-slots so that either three or four driving dogs may be used, and is graduated to facilitate rapidly setting each dog to the correct diameter. The faceplate pinion shaft is geared about 1 to 3 from the main driving shaft, thereby proportionately reducing the torsional strains.

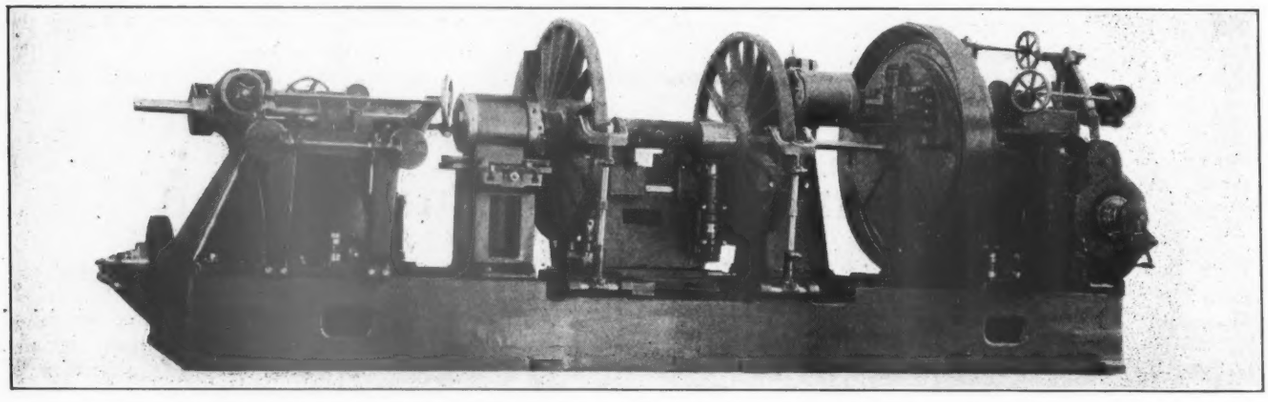
Each faceplate is equipped with four adjustable equalizing driving dogs. The serrated gripping member of each dog is adjusted up an incline against the tire by a hand-operated screw. Further travel of the gripping member, when the cutting tool takes hold, is regulated by check nuts, thus insuring uniform tightening of each dog by exactly the right amount to hold the wheel set with a minimum end thrust and at the same time prevent any tendency to spring the wheels.

Power traverse is by an individual motor through a powerful screw, the thrust of which is taken on roller bearings. A friction clutch allows the motor to be started under no load and is controlled by a conveniently located lever. This control is also equipped with an automatic trip, which throws the clutch when the tailstock has run back sufficiently to roll the wheels out of the machine.

The tailstock is clamped by two large bolts on the front and two on the rear which engage tee-slots in the bed. These bolts are set up by two wedges actuated by pneumatically operated right and left hand screws, thus equalizing the strain on each bolt and quickly and firmly clamping the tailstock to the bed. The tool rests have in and out adjustment on the bed sufficient to turn wheels from 28 in. to 86 in. in tread diameter. A rack and pinion conveniently located affords a rapid means for making this adjustment and with a scale graduated to wheel diameters, readily permits the operator to set either rest to accommodate any wheel size desired. Fast traverse for both cross and longitudinal adjustment is provided through large handwheels. The final setting of the tool for depth of cut is made by a wrench operating through reduction gears. An adjustable scale has been provided to aid the operator in topping the flange.

Each turret has a round nose rougher, flange rougher and a flange and tread finisher mounted all on one side of the block, and on the opposite side a tread chamfering and rounding tool. The roughing tool and all blades are secured to the block by hardened steel clamping plates, each tool independently detachable for regrinding. There are no screw holes or tongues in any of the blades, side movement being prevented by shoulders on hardened and ground members under the blades which engage the sides of the blades. Roughing the tread, roughing the flange and finishing the flange and tread are all done in sequence without unclamping or swiveling. After the flange and tread finishing tool has completed its work, the turret block is rotated 180 deg. and is so designed that swiveling brings the tools in position for tread chamfering and rounding, requiring practically no side adjustment. Locking of the turret in each of its two positions is accomplished by a large taper end bar entering a tapered recess in the swiveling block; this bar being operated by a lever and toggle device. The turret is further clamped in position by tightening the square head bolt in the center of the block. In order that the block may swivel with the least possible effort, a ball hearing and spring construction is provided whereby about 75 per cent of the weight of the block is taken on the ball bearing when the square head clamping bolt is released and the block itself is not, therefore, ever raised off its seat.

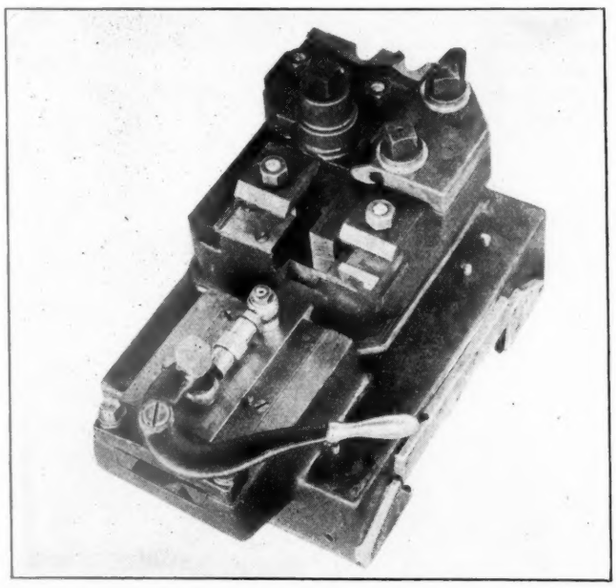
When turning ball or blind tires, mounted on the two-station turret tool block are four tools, a round nose rougher and a tread finisher on one side of the block and two tread chamfering and rounding tools on the opposite side. Roughing the tread and finishing the tread are both done in sequence without unclamping or swiveling.



The Putnam 90-in driving wheel lathe equipped for adjustable speed motor drive

After the tread finishing tool has completed its work, the block is rotated 180 deg. and as in flanged tire turning, this brings the tools in proper position for tread chamfering and rounding with practically no side adjustment.

A calipering attachment is furnished with all machines. It is of simple construction and enables the operator readily to size both wheels to the same diameter. Either the inside or outside journal turning attachments or both can be supplied when desired. There is power feed in each direction, independent of each other, for either journal turning or facing hub liners. With the inside attachment, both journals can be turned simultaneously. The base is made in two parts with a screw for sliding the upper section to facilitate the handling of wheels with long crank pins. Journal turning speeds may be readily provided on all machines. When so desired, the machine can be equipped with power cross feed for facing the sides of the tires.



Two-station turret tool block which holds four cutting tools

This machine can be arranged for turning and boring demounted locomotive tires. Four cast steel chucking members may be bolted to the faceplate using the same tee-slots as are provided for the driver dogs. Centering the tires is accomplished by means of a set screw in each chucking member and is facilitated by a centering device mounted on the spindle supporting nose piece.

Tire boring is done with tires mounted on the tailstock faceplate with a special boring bar which may be held in the right hand tool block. Tire turning may be done on either faceplate, using the same tools as are used for turning mounted tires. By using eight chucking members, four on each faceplate, and two centering devices, one tire may be turned on the headstock faceplate and one tire bored on the tailstock faceplate simultaneously or two tires may be turned simultaneously.

This machine can be arranged for single or double quartering. When the double, quartering attachment is used only right-hand lead wheel sets can have both wheels bored simultaneously. If a left-hand lead wheel set is to be handled, each pin hole must be bored in a separate operation.

For direct current motor drive a 3 to 1 adjustable-speed, 50-hp., 500 to 1,500 r.p.m., shunt wound motor with a wheel lathe control is recommended. The motor is mounted directly on the headstock. A 7½-hp., 1,000 r.p.m. constant speed tailstock traversing motor with reversing control is recommended for traversing the tailstock.

For alternating current motor drive, a constant speed, 50-hp., 900 r.p.m., slip ring motor with a wheel lathe control is recommended. The motor is mounted directly on the headstock gear box. Six speeds are provided for the faceplates. The changes in speed are made by two levers, mounted on the front of the headstock.

Equalizing driving head for axle lathe

TWO features adding to the convenience and productive capacity of the No. 3 double axle lathe have recently been introduced by the Niles Tool Works Division of the Niles-Bement-Pond Company, Hamilton, Ohio. Either or both of these features are offered as optional to the standard equipment, the one consisting of an equalizing driving head in place of the regular driving plate and driver dog, as shown in Fig. 1. An internal gear ring is mounted in the spool, the out-

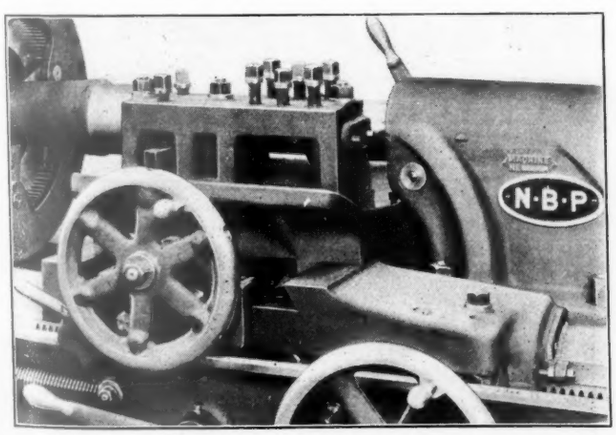


Fig. 2—Axle lathe provided with a multiple tool holder

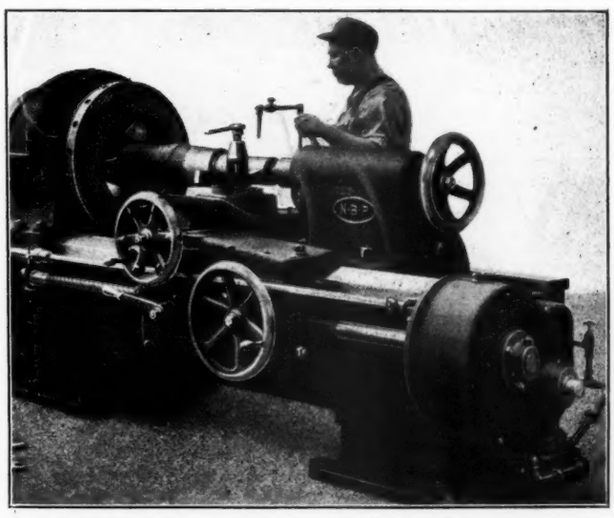


Fig. 1—No. 3 axle lathe with an equalizing driving head

side of which is drilled with equally spaced radial pin holes. There are three serrated driving dogs, the heel of each having a segment of a gear cut on it and meshing with the internal gear ring. Each dog swings on a pivot and is held in engagement with the axle by springs. However, once the dog comes in contact with the axle and the machine is started up, the pressure of the cut will increase its grip and prevent any slip. An equalizing feature in these drivers takes care of any eccentricity or roughness in the axle forging without distorting the axle, and each dog takes its equal share of the load. To release the dogs, a pinch bar is inserted into one of the radial pin holes which gives the rear ring a partial turn that opens the jaws. Provision is made so that the jaws may be held open for removing or inserting axles. Axles up to the full capacity of the machine can be driven by this driver with the one set of jaws as there is considerable rotary movement of the ring gear.

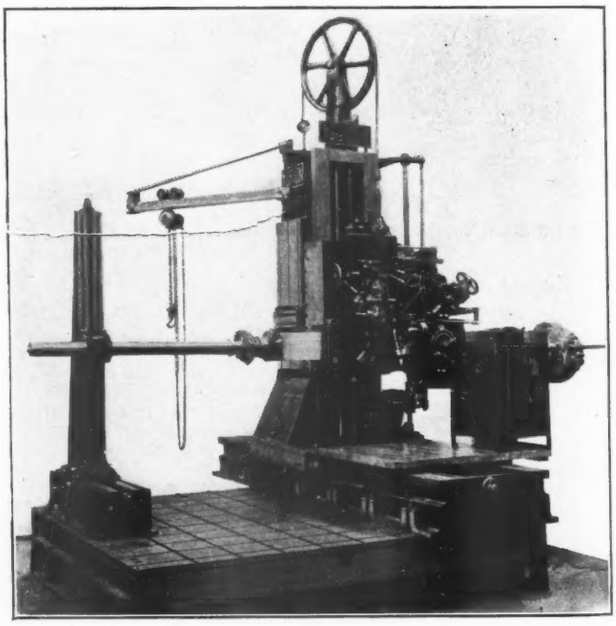
The other feature is a multiple toolholder as shown in Fig. 2. This toolholder carries four tools, each of which is so spaced and shaped as to perform its specific operation on the collar, journal, dust guard and wheel seat with a minimum of movement of the carriage. Means are provided for the proper location of the tools so that they may be withdrawn for sharpening and reinserted without destroying their relative positions with one another.

Morton 60-in. stroke draw-cut planer

THE 60-in. stroke draw-cut traveling head planer built by the Morton Manufacturing Company, Muskegon Heights, Mich., will perform many operations at one setting, such as planing, milling, boring, drilling, vertical milling and right angle boring. It has 9 ft. of horizontal travel on the bed, 5 ft. of vertical travel on the column and 60 in. of cutting stroke. It can be furnished with any length of bed or height of column, or can be furnished for shaping and planing only by the elimination of the boring, milling and drilling features.

The machine can be used either as a stationary or portable machine, as the bottom of the bed is planed. It can be quickly changed into a push-cut, converting it into a traveling head slotter. The milling and boring feeds are automatic and are easily and rapidly changed. They are controlled by one lever. The feed gear box has eight changes in each direction, giving a range suitable for all boring and milling. This is accomplished by a hollow steel arbor which passes through the ram and is properly journalled. The arbor is bored for receiving taper milling cutters, boring bars and other special equipment. When planing or shaping, the machine will automatically feed horizintally on the bed or vertically on the column.

When using a reversing motor drive, the power is transmitted by mitre gearing through a vertical shaft to the operating mechanism contained in the vertically moving apron. This eliminates the reversing clutches necessary when using direct current motor drive, thus eliminating one source of gear failure.



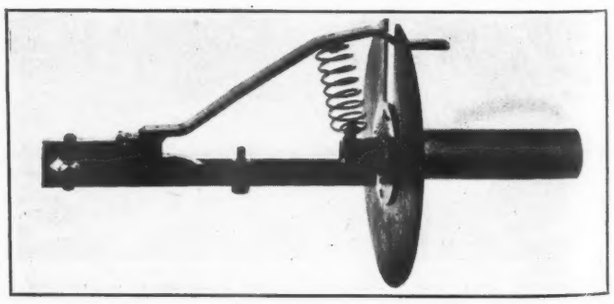
Morton planer arranged for boring and milling

Heavy current electrode holder

WITH the coming of heavy current welding, new accessories have been necessary in arc welding equipment. The accompanying illustration shows a 600-ampere metal electrode holder just brought out by The Lincoln Electric Company, Cleveland, Ohio. This holder handles metal electrode in sizes up to ½ in. diam. and is known as the type TR.

The holder has replaceable copper jaws, four-line contact for the electrode, and an all-copper path for the welding current. It is of structural steel construction and is light in weight with good balance. It has a cool insulated and ventilated handle and a shield for the protection of the operator's hand.

In handling heavy currents which are becoming com-

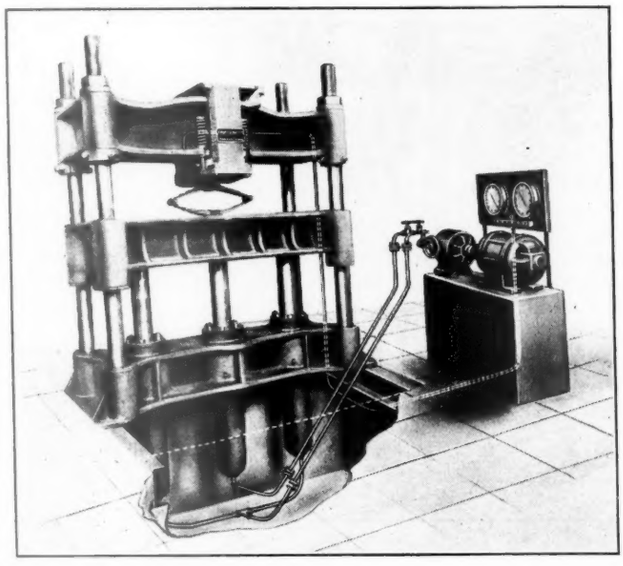


Electrode holder with insulated and ventilated handle and shield for the operator's hand

mon in manual metal electrode welding practice, the features mentioned are of importance. High current, high speed manual welding requires holders and accessory equipment designed to permit the operator to get the desired results with a maximum of comfort and protection.

A spring testing machine for railway shops

THE Emery-Tatnall Company, 400 Washington avenue, Philadelphia, Pa., has placed on the market a spring testing machine that accommodates the largest elliptic locomotive springs now made or anticipated in the future. It has a clear space of 7 ft.



A spring testing machine that will handle the largest locomotive springs now made

between the columns, a 34-in. stroke and a capacity of 200,000 lb.

The machine has three cylinders, all alike. When testing long elliptic springs, the two outside cylinders act. For coil springs or spring groups, the center cylinder alone is required. Selective control is obtained at the valve station beside the pump unit. A spring of any size may be swung directly into the machine from the front and removed at the rear, because of the wide span of the platen. Loss of time and inconvenience of pushing springs in from the ends are eliminated. A single operator handles the test. Standing in front of the machine, he has complete control of operation through the small hand wheel on the pump. Without moving he can read the loads, automatically indicated on large open face dials. He reads the spring deflections on a dial deflectometer, built into the machine, but not shown in the illustration.

The weighing system of this machine is located on the top platen, and consists of an Emery hydraulic support which is independent of the top platen and lies in a spring gripped cradle. The support is connected directly to the visual indicators which indicate continuously the load readings. This weighing system is equally accurate for light or heavy loads. It is equally satisfactory for compression or release methods of testing.

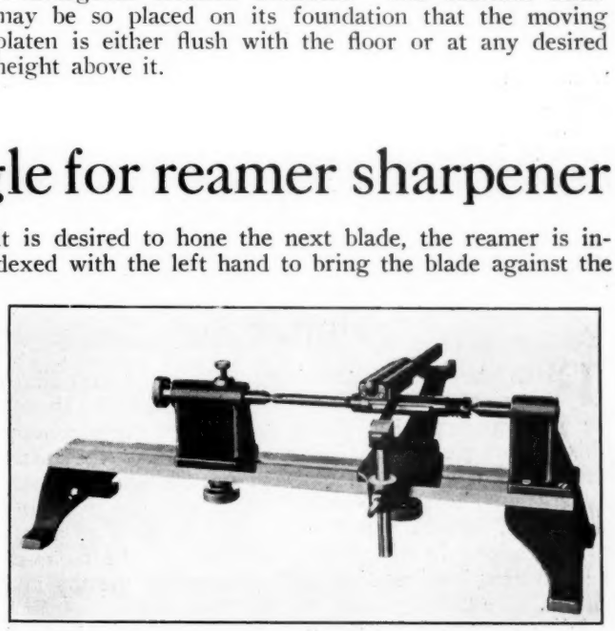
A separate power plant makes this equipment independent of the fluctuating pressures in the plant's system. Unusual flexibility and complete freedom from pulsation results from the use of a small, direct motor-driven rotating cylinder pump, running continuously in one direction. The control wheel on the pump has a zero point. When it is turned to the left, the platen rises at a speed proportional to the angular displacement of the control wheel from its zero position. This speed may be anything from zero to 80 in. per min. when the center cylinder is operating alone, or 40 in. per min. with two cylinders operating. If the wheel be turned back past zero and then on to the right, the platen travels downward at any desired speed.

The pump unit and the instrument board are separate from the machine and thus may be placed in the most advantageous location available. The machine itself may be so placed on its foundation that the moving platen is either flush with the floor or at any desired height above it.

Adjustable clearance angle for reamer sharpener

STRAIGHT-BLADED reamers, both solid and expansion types, may be conveniently sharpened in a redesigned bench machine manufactured by the Foster-Johnson Reamer Company, Elkhart, Ind. This equipment is intended for sharpening reamers with centered ends up to 16 in. in length and 5 in. in diameter. One of the features of the machine is that the spring tooth which supports the reamer blades while they are being sharpened and the rest which guides the hone, are both adjustable to suit any clearance angle.

For the sharpening operation, the reamer is mounted between the centers of the headstock and tailstock as shown. The operator grasps the hone handle with the right hand and holds the reamer blade firmly against the spring tooth by means of the left hand. While exerting a slight pressure on the hone, the latter is drawn back and forth over the top of the reamer blade. When it is desired to hone the next blade, the reamer is indexed with the left hand to bring the blade against the

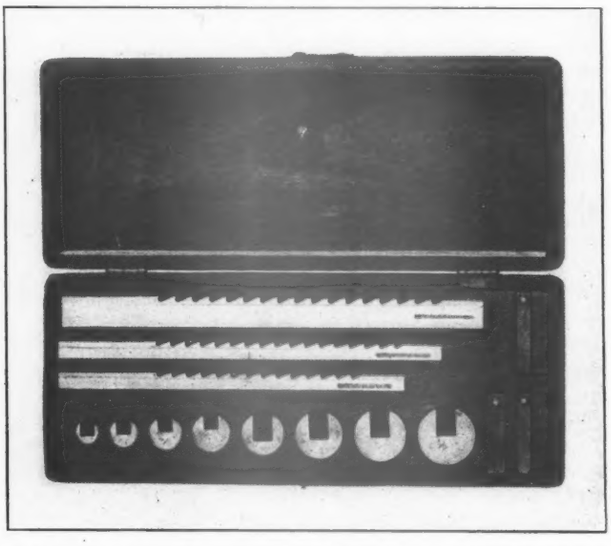


Machine for sharpening solid and expansion reamers

spring tooth. It is considered best practice to take a few strokes at a time on each blade, continually indexing the reamer until it has been completely sharpened. About the same number of strokes should be made on all blades.

Keyway broaching set for the machine shop

A HANDY keyway set consisting of three cutterbars, three shims and eight work bushings which can be used on an arbor press, has been placed on the market by the J. N. LaPointe Company, New London, Conn. This set has been developed to meet the demand of machine shops that do not have sufficient work to warrant the purchase of a broaching machine and its equipment. With this set splines may be cut in cams, pulley hubs, gears, levers and numerous other parts, either in metal or fibre. If more than one spline is wanted in a single piece, the work bushing is set at the proper angle and the original operation repeated.



A keyway broaching set for shops not provided with a broaching machine

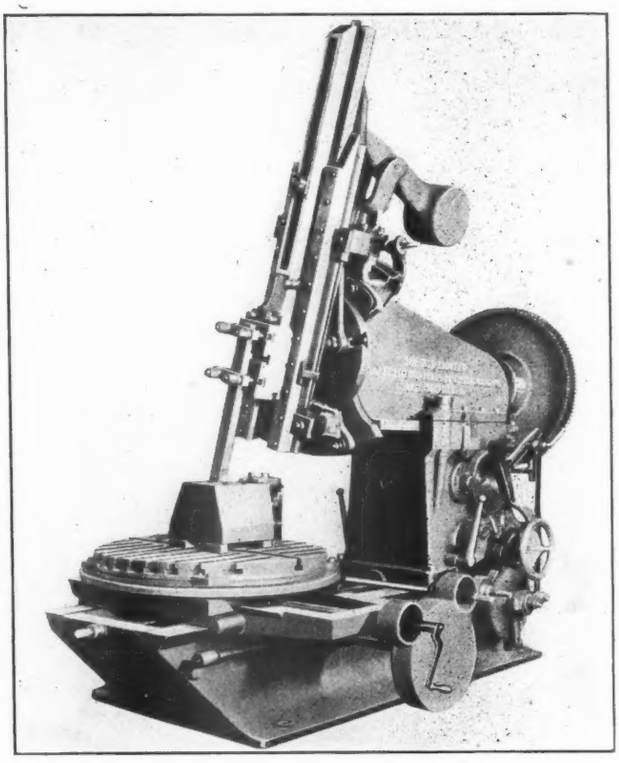
The set can cut twelve sizes of keyways from ⅛ in. up to 12 in. long. The diameter of the work bushings range from ⅝ in. up to and including 1½ in.

Angle cutting, traveling head slotter

THE latest developments made by the Nazel Engineering & Machine Works, Philadelphia, Pa., to the Dill traveling head slotter is an angle cutting head. This feature permits a 15-deg. adjustment of the cutter head on each side from the center, making the slotter universal. The angle cutting head, with the ram and ram guide, forms a separate unit and is fitted on a hub turned concentric with the crank shaft on the front of the traveling head and securely clamped at the top and bottom.

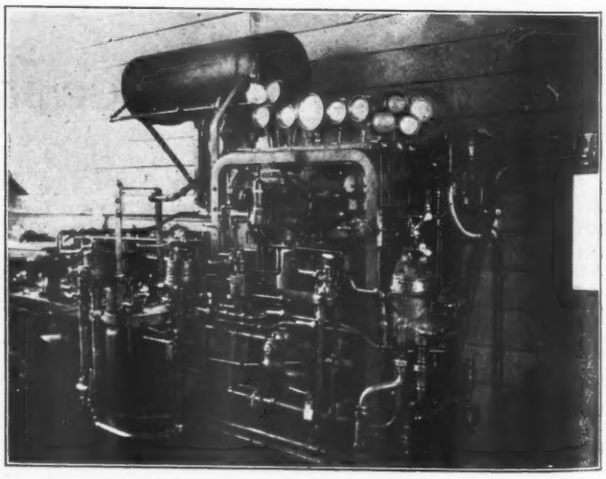
Adjustments of the angle cutting head are obtained through a worm which is secured by brackets to the traveling head and a worm rack bolted to the angle adjusting head. The angle cutting head is indexed in degrees and, for accurate adjustment, a dial, indexed in minutes, is placed on the worm angle adjusting shaft.

The ram guide is fitted with taper gibs in the top and bottom which prevent springing when the cutting thrust is against the gib side.



The Dill 24-in. slotter with the angle cutting traveling head extended over the table and cutting a 15-deg. angle

The angle cutting head, in connection with the traveling head feature of the Dill slotter, makes this machine especially adaptable for the machining of angular surfaces at one setting which operation heretofore required a setting for each side.



Standard No. 6 E. T. test rack recently rebuilt at the Milwaukee shops of the C. M. & St. P. for the testing of automatic train control equipment—Similar racks are located at Minneapolis and St. Paul, Minn.

News of the Month

Chicago, Rock Island & Pacific.—A contract for the construction of locomotive repair shop facilities, including a one-story machine shop addition, at Silvis, Ill., at a cost of about $125,000, has been let to the T. S. Leake Construction Company, Chicago.

The International Brotherhood of Stationary Firemen, Oilers and Railway Shop Laborers has elected John F. McNamara of Boston, Mass., as president. Mr. McNamara succeeds Timothy Healy who was defeated for re-election after serving as president for 24 years.

Supplement No. 1 to the rules of interchange

A supplement to the current Rules of Interchange has been prepared by the Arbitration Committee and the Committee on Prices for Labor and Material which includes modifications of Rules 1, 3, 16, 19, 30, 36, 66, 86, 101, 107, 111, 112 and 120 of the freight car code and Rules 21 and 22 of the passenger car code. Those desiring copies of the supplement may receive them by writing to V. R. Hawthorne, Secretary, A. R. A., 431 South Dearborn street, Chicago.

Four technical societies meet at Detroit during week of September 19

More than 25,000 executives, shopmen and scientists of metal working and trading industries all over the world will gather in Detroit the week of September 19 for the technical sessions of four associations and for the National Steel and Machine Tool Exposition, according to estimate of W. H. Eisenman, secretary of the American Society for Steel Treating which has its headquarters in Cleveland.

During the week the exposition is running in Convention Hall, Detroit, the American Society for Steel Treating, the Institute of Metals, the Society of Automotive Engineers, and the American Welding Society will be meeting twice daily, from Monday through Friday, in the Statler and Book-Cadillac Hotels, Detroit, to hear papers read by some of the steel industry's foremost metallurgists, some of its best known engineers, and some of its most capable executives.

The American Society for Steel Treating will discuss the manufacture, use and treatment of iron and steel. The Institute of Metals will take up non-ferrous metals. The production meeting of the Society of Automotive Engineers will go into the latest methods of production in all departments of manufacture. The American Welding Society, which joins its discussions and exhibits with the others for the first time this year, will take up the latest developments and uses of welding equipment and material.

Fall meeting of the American Welding Society

The tentative program for the fall meeting of the American Welding Society to be held in Detroit, Mich., September 19, 20, 21, 22 and 23, at the Book-Cadillac hotel, is as follows:

MONDAY, SEPTEMBER 19

2 P. M.

Meeting of board of directors.

7:30 P. M.

Meeting of the American Bureau of Welding.

TUESDAY, SEPTEMBER 20

10 A. M.

Airplane welding, by J. B. Johnson, chief of material branch, War Department, Air Corps, McCook Field.

Welding on the long distance aircraft by the Atlantic Aircraft Corporation.

2 P. M.

Report of San Francisco Section's investigation on "Study of welds subjected to high temperatures."

Heat treatment by the oxy-acetylene flame, by E. E. Thum, associate editor, Iron Age.

A metallurgical study of welds, by G. R. Brophy, Research Laboratory, General Electric Company.

WEDNESDAY, SEPTEMBER 21

10 A. M.

Car welding, by Victor Willoughby, general mechanical engineer, American Car & Foundry Company.

Automobile welding, by W. C. Happ, chief engineer, Department of Methods and Standards, Studebaker Corporation.

2 P. M.

Inspection tour to the River Rouge plant of the Ford Motor Company and to the plant of the Fisher Body Corporation.

7:30 P. M.

Meeting of Structural Steel Welding Committee.

THURSDAY, SEPTEMBER 22

10 A. M.

Production welding of water heaters, by H. J. Grow, Air Reduction Sales Company.

Welding in the plant of the Combustion Engineering Corporation, by C. S. Reed, vice-president and general manager.

2 P. M.

Welding of structural steel, by Joseph Matte, Jr., of Albert Kahn, Inc.

Welding in the design of steel plate work, by L. J. Sforzini, Engineering and maintenance department, Eastman Kodak Company.

6:30 P. M.

Annual fall dinner dance of the American Welding Society.

An interesting program has been worked out for the entertainment of the ladies.

The welding and cutting exposition held under the auspices of the American Welding Society and in co-operation with the National Steel and Machine Tool Exposition in Detroit, the week of September 19, will be the largest exhibit of its kind ever held. A special section of the convention hall of over 10,000 sq. ft. has been set aside for the welding exhibit.

Domestic railway purchases of locomotives, freight cars, passenger cars, structural steel and rails

	Locomotives		Freight cars		Passenger cars		Structural steel		Rails	
	1927	1926	1927	1926	1927	1926	1927	1926	1927	1926
January	26	60	17,196	11,531	314	217	6,417	6,845	29,000	20,000
February	85	13	4,185	11,353	246	152	620	5,998	68,500	46,200
March	70	407	5,253	8,772	212	112	12,150	12,010	.....	.....
April	27	48	3,362	4,490	6	225	6,120	8,595	12,300	.....
May	184	50	4,378	435	261	30	17,895	21,200	.....	81,540
Total five months	392	578	34,374	36,581	1,039	736	43,202	54,648	109,800	147,740

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—T. L. Burton, 165 Broadway, New York.

American Railroad Master Tinners' Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 13 to 20, 1928, inclusive, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Convention Hotel Kentucky, Louisville, Ky., Sept. 13, 14 and 15.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention, Chicago, August 31, September 1 and 2.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual meeting, September 19-23, at Detroit.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York. Annual meeting September 19-23, at Detroit.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C & N. W. Station, Chicago, Ill. Annual meeting, Hotel Sherman, Chicago, October 25-28.

Birmingham Car Foreman and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago.

Car Foremen's Association of St. Louis.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Thursday each month, except June, July and August at Hotel Statler, Buffalo.

Chief Interchange Car Inspectors' and Car Foremen's Association.—(See Railway Car Department Officers' Association.)

Cincinnati Railway Club.—D. R. Boyd, 811 Union Central Building. Regular meeting second Tuesday, February, May, September and November.

Cleveland Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave., Cleveland.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.

International Railway Fuel Association.—L. G. Plant Railway Exchange, 80 E. Jackson Boulevard, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.

Louisiana Car Department Association.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Car Department Officers' Association.—A. S. Sternberg, Belt railway. Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, August 23, 24 and 25.

Railway Club of Greenville.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month, Terminal Hotel bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September 13-16, 1927.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June July and August.

Supply Trade Notes

The Pennsylvania Pump & Compressor Company, Easton, Pa., has appointed the P. I. Perkins Company, 110 High Street, Boston, Mass., as its representative in the Boston territory.

The Birmingham, Ala., laboratory and office of the Pittsburgh Testing Laboratory of Pittsburgh, Pa., has been moved into a new building where a Riehle testing machine of 400,000-lb. capacity has been installed.

M. J. Harkless has been appointed sales engineer of the contractors' department of the Independent Pneumatic Tool Company, Chicago. Mr. Harkless was previously an engineer of the railway and marine supply department of the Buda Company, Harvey, Ill.

The Eichman Machinery Company, Kansas City, Mo., now represents the Whiting Corporation, Harvey, Ill., in Kansas and part of Missouri. The Huey & Philip Hardware Company, Dallas, Texas, represents the corporation in Oklahoma and part of Texas; L. H. Staley, New Orleans, La., represents the corporation in Louisiana, the southern half of Mississippi, and in the city of Mobile, Ala., and the H. B. Wilson Company, St. Louis, Mo., represents the corporation in Arkansas. The Whiting Corporation will build a one-story addition to its plant to cost $35,000.

Charles R. Ellicott, eastern manager of the Westinghouse Air Brake Company, has been elected resident vice-president with headquarters at New York. Mr. Ellicot was born in Chicago, where his early education was received. In 1902 he was graduated as a bachelor of science from the Sheffield Scientific School of Yale University. He entered the employ of the Westinghouse Air Brake Company in August of that year, as a special apprentice in the Wilmerding shops, and was later appointed mechanical expert at New York. From 1905 until 1912 he served as representative of the company, first in New York and then in Boston. He was appointed assistant eastern manager in 1912 and promoted to eastern manager in 1920.

Charles R. Ellicott

Thomas Mahar has been appointed manager of the service department of the American Arch Company, with headquarters at New York. He was born in Oswego, N. Y., and graduated from the public schools. Entered service of the Rome, Watertown & Ogdensburg, now part of the New York Central, at Oswego. He became roundhouse foreman at Chatham, N. Y., in 1903, and general foreman at Mott Haven and Highbridge from 1904-1907. He was then general foreman at Rensselaer and Albany until 1909, and master mechanic from 1909 to 1913, when he resigned to go with the American Arch Company as traveling engineer.

The Lincoln Electric Company, Cleveland, Ohio, has made changes and additions in its sales and service department as follows: L. P. Henderson of the Detroit office has been transferred to Chicago in charge of welder service; J. E. Durstine has been transferred from the experimental engineering department to the welder service department at Cleveland; J. W. Shugars of the time study department at Cleveland, and R. D. Layman, also of Cleveland, have been transferred to Detroit under the direction of J. M. Robinson; D. H. Carver has been transferred from the machine shop division at Cleveland to the Ohio service division, with headquarters at Cincinnati, Ohio, and R. F. Terrill

has been transferred from the general engineering department at Cleveland to the eastern service division at New York.

P. William Kromer, Buffalo district manager of the Air Reduction Sales Company, New York, died at the Buffalo General Hospital on May 21, at the age of 47, following an illness of five weeks. Mr. Kromer had been identified with the oxyacetylene industry for nearly 20 years, of which 11 years were with the Air Reduction Sales Company. Immediately prior to his connection with the Air Reduction Sales Company in 1916, he was the local manager of the Niagara Oxygen Company. His previous experience had been with the Searchlight Company and other producers of gases, and as manager of a job welding shop in Binghamton, N. Y.

Carl H. Beck, for seven years assistant eastern manager for the Westinghouse Air Brake Company, at New York, has been appointed general sales manager of the company with headquarters at Wilmerding, Pa. Mr. Beck was graduated from the Pennsylvania State College in 1905 and in 1911 received his M. E. degree from the same college. He entered the employ of the Westinghouse Air Brake Company as a special apprentice in 1905, and after filling special shop and field assignments, was transferred to the St. Louis office in 1907, and given the position of steam road inspector. In 1909 he was advanced to representative of the Westinghouse Traction Brake Company in the same city, which position he held until 1919, when he was made special representative of the Safety Car Devices Company at Wilmerding. Mr. Beck's next promotion came in 1920, when he was made assistant eastern manager of the Westinghouse Air Brake Company, which position he held until his new appointment.

Carl H. Beck

George C. Murray, formerly president of the Keyoke Railway Equipment Company, Chicago, who died on May 22, was born on September 27, 1866. He became connected with the Simplex Railway Appliance Company in 1902, and was engaged by the American Steel Foundries, Chicago, when the latter company absorbed the Simplex organization in 1905. Patents were obtained by Mr. Murray in 1909 and 1910 on the Murray draft gear and the Murray Keyoke and at this time he formed and became president of the Keyoke Railway Equipment Company. He remained president of this company until about two years ago when he gave up all business activities on account of ill health.

The amalgamation of the sales forces of the National Machinery Company, Tiffin, Ohio, with those of the Chambersburg Engineering Company, Chambersburg, Pa., was recently completed. The Chambersburg Engineering Company manufactures a line of forging and pressing machinery, including steam hammers, hydraulic presses, hydraulic riveters and related lines, while the National Machinery Company manufactures forging machines and a line of bolt and nut machinery. Outside of the amalgamation of selling forces, the two companies will remain as distinct and separate organizations, there being no change in ownership, management or personnel. Sales offices will be maintained in Tiffin, Chambersburg, New York, Chicago and Detroit.

Eric H. Ewertz, general manager of the Moore plant of the Bethlehem Steel Company, has resigned to open an office as an independent consulting engineer at 50 Church street, New York. Mr. Ewertz will deal with problems relating to welding, mechanical and economic engineering. A graduate mechanical engineer, he has had 30 years' experience in engineering fields, including the management of large manufacturing plants. Among the enterprises with which he has been connected are the Navy Yard, Sweden; Schwartzkopf Machine Company, Berlin, Germany; Victor Metals Company, Braintree, Mass.; Bethlehem Steel Company, Elizabeth, N. J., and a number of shipbuilding organizations. This experience covers construction and design of machinery and parts and structural work. Mr. Ewertz is one of the founders of the American Welding Society and a past president of that organization.

Theodore F. Merseles has been elected president of the Johns-Manville Corporation, New York, to succeed H. E. Manville, who has been elected chairman of the board. Theodore F. Merseles was born in Jersey City, N. J., on August 17, 1863. He entered railway service as a clerk on the Pennsylvania at Jersey City and later became a clerk for the Trunk Line Association at New York, which position he held until 1893. From the latter date until 1899 he was manager and vice-president of the Western Wheel Works at Chicago, and during the following three years assisted in organizing the American Bicycle Company of New York and was its vice-president. In the latetr year he became vice-president and general manager of the National Cloak & Suit Company at New York, and in 1921 he was elected president of Montgomery Ward & Co., which position he has held until his recent election.

J. Dalrymple Rogers, formerly manager of the London, England, office of the Baldwin Locomotive Works, has been appointed London representative of the International Railway Supply Company. Mr. Rogers was graduated from Virginia Polytechnic Institute in 1906 and for the two years following served as an apprentice on the Chesapeake & Ohio. In 1909 he was graduated from Cornell University and from that time until 1913 was a machinist (subsequently a foreman) on the Virginian. He then went with the Union Pacific as enginehouse foreman at Pocatello, Idaho; was next general foreman of the Pere Marquette at Detroit, Mich.; and then superintendent of shops of the Virginian. From 1917-1919 he was with the U. S. Engineer Corps in Russian railway service and on staff duty in Washington, D. C. From 1919 to 1922 he was representative of the Baldwin Locomotive Works in South Africa; 1922-1924 manager, India office of same company at Calcutta; and 1924-1926 London manager.

Alexander Beal Brown, general representative, air brake department, Canadian Westinghouse Company, Limited, died at his home in Montreal, Que., on Wednesday, June 8, after an illness of several months. Mr. Brown was born June 6, 1873, in Scranton, Pa., where his father was assistant superintendent, motive power of the Delaware, Lackawanna & Western. After completing his education in the public schools at Scranton in 1887, he entered the employ of the Delaware, Lackawanna & Western as an apprentice in the machine shop. Later he was transferred to the air brake inspection department and made assistant to the air brake inspection foreman. In 1897 he became an assistant on the air brake instruction car operated by the Westinghouse Air Brake Company. Subsequently he was made inspector of the Westinghouse Air Brake Company at Buffalo, where he remained until 1903, when he was transferred to Hamilton, Canada, to act in a similar capacity with the Canadian Westinghouse Company. Since that time, his connection with the Canadian Westinghouse Company has been uninterrupted. L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee St. Paul, was in Montreal as chairman of the Mechanical Division meeting of the American Railway Association at the time of Mr. Brown's death. He paid a high tribute to Mr. Brown because of his interest in helping his fellows and particularly in assisting the younger men. It was Mr. Brown who helped to get Mr. Sillcox started on his railroad career.

A. B. Brown

Personal Mention

General

N. L. Wiggin has been appointed system fuel supervisor of the Boston & Maine with headquarters at Boston, Mass., duties to be assigned.

J. R. Annis has been appointed fuel supervisor of the Portland division of the Boston & Maine, with headquarters at Portland, Me., succeeding N. L. Wiggin.

W. H. McClenathan has been appointed fuel supervisor of the White Mountains, Passumpsic and Southern division (north of Concord, N. H.) of the Boston & Maine, with headquarters at Woodsville, N. H., succeeding Mr. Annis.

L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has requested and been granted a leave of absence of two months. All officers and employees in the locomotive department will report to R. W. Anderson, superintendent of motive power of the Eastern lines, with headquarters at Milwaukee, Wis., and those in the car department will report to K. F. Nystrom, who has been promoted to master car builder, succeeding C. J. Juneau, deceased.

Master Mechanics and Road Foremen

C. G. Slagle, superintendent of motive power, C. I. & W., has been appointed master mechanic of the Indianapolis division of the B. & O.

J. M. Whalen, master mechanic of the Missouri Pacific at St. Louis, Mo., has had his jurisdiction extended to cover the entire St. Louis terminal.

H. C. Wells has been promoted to assistant road foreman of engines of the Scioto division of the Norfolk & Western, succeeding A. A. Edmonston.

Charles Furness, supervisor of engine-houses of the Boston & Maine at Boston, Mass., has been appointed acting master mechanic of the Portland division.

C. A. Fisher, fuel supervisor on the Great Northern, with headquarters at Hillyard, Wash., has been promoted to master mechanic, with headquarters at Grand Forks, N. D.

A. A. Edmonston, assistant road foreman of engines of the Scioto division of the Norfolk & Western, has been appointed road foreman of engines of the Shenandoah division.

W. A. Curley, master mechanic of the Missouri division of the Missouri Pacific at Poplar Bluff, Mo., has been transferred to the Little Rock division, with headquarters at McGehee, Ark.

F. E. Boehm has been appointed road foreman of engines of the Fort Wayne division of the Western region of the Pennsylvania, with headquarters at Fort Wayne, Ind., succeeding E. A. Burchiel, promoted to trainmaster.

L. W. Thurston has been appointed road foreman of engines of the Portland division of the Boston & Maine, with headquarters at Portland, Me. Mr. Thurston will give particular attention to interdivision service between Portland and Worcester, Mass.

W. E. Harmison, master mechanic on the Western district of the Erie, with headquarters at Kent, O., has been transferred in the same capacity to Port Jervis, N. Y., and is in charge of mechanical work on the Delaware & Wyoming divisions.

Shop and Enginehouse

Bernard Cook, mechanical inspector of the Norfolk & Western at Roanoke, Va., has been appointed general foreman, locomotive department.

F. S. Tinder has been appointed shop superintendent of the Virginian, with headquarters at Princeton, W. Va., succeeding Frank Welboan, deceased.

Wallace W. Brown has been appointed supervisor of engine-houses of the Boston & Maine, reporting to the general inspector of locomotive maintenance, with headquarters at Boston, Mass. Mr. Brown succeeds Charles Furness.

Car Department

O. C. Farris has been appointed car foreman of the Norfolk & Western, with headquarters at Clare, Ohio, succeeding J. S. East.

W. B. Shea, general car inspector of the Missouri, Pacific at Kansas City, Mo., has been appointed superintendent of shops at DeSoto, Mo.

J. S. East, car foreman of the Norfolk & Western at Clare, Ohio, has been appointed car inspector of the Pocahontas division, with headquarters at Bluefield, W. Va.

K. F. Nystrom, engineer of motive power and rolling stock, at Chicago, has been promoted to master car builder, with headquarters at Milwaukee, Wis., succeeding C. G. Juneau, deceased. The position of engineer of motive power and rolling stock has been abolished. Mr. Nystrom was born in September, 1881, in Sweden, graduating from a Swedish university in 1904 as a mechanical engineer. Soon after coming to the United States in November, 1905, Mr. Nystrom entered the service of the Pressed Steel Car Company as a draftsman, where he remained until February, 1909, when he joined the engineering staff of the Pullman Company. In September of the same year he entered the mechanical department of the Southern Pacific, becoming assistant mechanical engineer of the American Car & Foundry Company in June, 1911, and mechanical engineer of the Acme Supply Company, Chicago, in July, 1912. Mr. Nystrom returned to railway service in September, 1913, when he was appointed chief draftsman of the car department of the Grand Trunk, with headquarters at Montreal, Que., remaining in that position until November, 1918, when he was appointed to a similar post on the Canadian Pacific. In January, 1920, he returned to the Grand Trunk as engineer of car construction. Mr. Nystrom's connection with the Milwaukee began in January, 1922, when he was appointed engineer of car design. He was promoted to engineer of motive power and rolling stock at Chicago in January, 1925.

K. F. Nystrom

Purchases and Stores

D. E. Vinson has been appointed storekeeper of the Chicago, Rock Island & Pacific, with headquarters at Topeka, Kan.

George E. Johnston, storekeeper of the Boston & Albany at Allston, Mass., has been appointed general storekeeper, with headquarters at West Springfield, Mass., succeeding F. S. Austin.

John H. Nichols, general storekeeper of the Nickel Plate district of the New York, Chicago & St. Louis, at Cleveland, Ohio, has been promoted to general storekeeper of the entire system, with headquarters at the same point.

Obituary

Charles Henry Ford, for more than 30 years master mechanic of the Boston & Maine repair shops at Worcester, Mass., died on July 14. Mr. Ford was 70 years old.

E. L. Mauk, master mechanic of the Tennessee Central, was crushed to death on Sunday, July 17, when the chain holding a wrecked tank car, under which he was working, gave way.